LOGISTICS TRANSFORMATION: CENTRALIZING AIR FORCE LOGISTICS INFORMATION COMMAND AND CONTROL

THESIS

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AFIT/GLM/ENS/01M-04

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AFIT/GLM/ENS/01-M-04

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THESIS

Presented to the Faculty

Department of Operational Sciences

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Engineering and Environmental Management

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March 2001

AFIT/GLM/ENS/01-M-04

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Acknowledgments

No effort like this is ever completed without the support of those one works and lives with. First, I would like to express my appreciation to those at the Air Force Institute of Technology (AFIT) for providing the opportunity and the tools to accomplish in this endeavor. Specifically, my thanks go to my advisor, Major Marvin Arostegui, and my reader, Major Stephan Brady, for supporting my desire to engage this topic and for providing direction toward the Decision Analysis and Value Focused Thinking courses offered at AFIT and bearing with me though it all. I wish also to acknowledge the three Decision Analysis instructors I had the opportunity to learn form over the past nine months: Dr. Richard Deckro, Lieutenant Colonel (ret) Jack Kloeber, and Captain Stephen Chambal.

I want to thank all those at Air Force Material Command that supported me in this study. Specifically, Colonel Gary McCoy, Colonel Gary Ryden, Colonel Malvin Hayes, Col Donald Pipp, Lieutenant Colonel Mark Douglas, Mr Barry Oliver, Mr Howard English, Ms Margie Osterhus, Mr John Frabotta, Captain Lee Lane, and Captain Kieran Keelty.

Finally, I want to thank those that put up with the most, my friends and family. Especially, my wife and my two boys, thank you for your support, encouragement, and understanding through all the stress and chaos.

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Abstract

Current Air Force logistics information systems do not provide Air Force Material Command leaders and single managers a single source for real-time logistics related information that can be used to assess current capabilities and identify potential future problem items prior to the items becoming systemic problem parts. Centralizing information may provide improved command and control and support of the warfighter by reducing the time it takes to track down and identify information. Using a Value Focused Thinking approach, this thesis explored how the Air Force can improve the accessibility of Air Force logistics information. This study began at the behest of the AFMC LG/CD in an effort to determine what logistics information is important and how it might be centrally accessed. Working with Air Force Materiel Command Logistics Group personnel, a value-based evaluation tool was developed that can be used to establish core requirements for an ideal centralized logistics information system. The value model was used to evaluate the status quo and two AFMC systems, WSMIS-SAV and TRACKER. This provides a base-line value of the current system and demonstrates how the model can be applied to evaluate other alternatives. The results show the status quo was the lowest ranking alternative.

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I. INTRODUCTION

I.1 Overview

Since the end of the Cold War, the way America plans to fight and support the war fighter has been evolving. However, in the area of logistics information, very little has changed in the way that information is gathered and put to use to improve mission support.

The Logistics mission is changing based on the vision established by the Joint Chiefs of Staff as originally published in Joint Vision 2010, and updated recently in Joint Vision 2020. In the logistics arena, we have been tasked to provide Focused Logistics.

> Focused Logistics is the ability to provide the joint force the right personnel, equipment, and supplies in the right place, at the right time, and in the right quantity, across the full range of military operations. This will be made possible through a real-time, web-based information system providing total asset visibility as part of a common relevant operational picture, effectively linking the operator and logistician across Services and support agencies. Through transformational innovations to organizations and processes, focused logistics will provide the war fighter with support for all functions (DoD JV 2020, 2000: 24).

At Headquarters Air Force Installation and Logistics, a team has been assembled to assess how Air Force Logistics will transform to meet the new demands placed upon it by the changing mission. The new system will be an "integrated logistics network that enables asset, process and service visibility, in-process redirection, efficient use of inventory, and increased customer confidence and control" (LTT, 2000: 3). The Logistics Transformation Team (LTT) has established eight attributes that the transformed Air Force Logistics system will have: Sustainable World Class Performance, Customer/Product Focus, Centered on the Logistician, Command and Control, End to End Perspective, Process Oriented, Balancing Performance and Cost, and Flexibility. This effort will concentrate on the areas of Command and Control and Flexibility.

I.2 Background

During the 1990s, the surge in growth in information technology has opened a world of new avenues for the collection and management of information; enabling decision makers in all types of organizations to improve the quality of their decisions and increase their trust in the information they are provided. In addition, because of the rapid growth in this field, the Department of Defense, specifically the Air Force, has had a difficult time taking advantage of the new technologies being developed. A Master's Thesis conducted at AFIT in 1994 by Captain Eric Lorraine and Captain Michael Michno investigated the use of a centralized Logistics Control Facility to improve asset visibility. Through their research and modeling efforts, they determined that the Air Force would benefit from adopting many industry-used technologies for identifying and tracking

assets, recommended a physical center to provide command and control of the logistics information, and described the organizational structure of this center (Lorraine and Michno, 1994:Chapter 5).

Since 1994, the asset tracking and managing tools have improved with the advances in computer and information technologies. The commercial sector has continued to advance, and the use of data warehouses to store and transfer data has become a recent addition to the information management toolbox. Customers of companies like FedEx, UPS, and the USPS can get online and track a shipment or package as it moves through the system from order to delivery.

In 1997, Headquarters USAF Installation and Logistics Plans and Integration Directorate (HQ USAF/ILX) tasked the Air Force Logistics Management Agency (AFLMA) with examining the Air Force's Logistics Processes. This study was to look for reengineering opportunities, prioritize those opportunities, and provide recommendations. In December1998, the AFLMA published their Phase II report. The report focuses on the 1st Fighter Wing at Langley AFB, VA, but includes information from several other Air Combat Command bases and their related reengineering initiatives, such as the combined Supply/Transportation Squadron at Shaw AFB. Due to the enormity of Air Force Logistics Management, the study was restricted to Aircraft Asset Management (Adamson and Tribble, 1998: 3). While the study provides conclusions and recommendations on ways to improve the distribution system, little is said about improving the visibility of the assets in the system, or using the information to improve decision-making. One of the

final recommendations is that further research should be conducted (Adamson and Tribble, 1998: 57).

This follows what Major Michael Salvi states in his 1999 final report for completion of the Naval War College. His report is on whether there is a need for a theater-level Joint Forces Logistics Commander. This commander must have access to timely and accurate logistics information in order to support the requirements set forth by the JCS in their vision. He compares the services in their efforts to respond to the requirement for *Focused Logistics* and comes to the conclusion, "Of all the Services, the Air Force has accomplished the least in developing new logistics doctrine and organizations in support of JV2010" (Salvi, 1999:5).

In comparison, the Navy started designing its Logistics Management Decision Support System (LMDSS) in 1991. This system was chartered to provide the Navy a tool to "investigate alternatives and make optimal, unstructured decisions in their efforts to reduce life cycle program costs while maintaining readiness" (Krause and Evanhoff, 1999: 1). Since that time, the Navy's desire to incorporate the latest technology into the system has kept the system in the development stage and from being fielded (Krause and Evanhoff, 1999). Krause and Evanhoff's thesis research resulted in the conclusion that the system could provide useful information, but it lacks modeling capabilities to provide decision testing. The current web-based configuration of the system, however, provides a lot in the way of a management information system. They recommend incorporating a data warehouse that would build a historical database that could be used for future model

test and development (Krause and Evanhoff, 1999: 113-115). However, the ideas and lessons learned from the system development strongly support this thesis initiative.

I.3 Problem Statement

Current Air Force logistics information systems do not provide Air Force Material Command (AFMC) leaders and single managers a single source for real-time logistics related information that can be used to assess current capabilities and identify potential future problem items prior to the items becoming systemic problem parts.

I.4 Research Question

How can the visibility of Air Force logistics related information be improved to near real-time in order to take advantage of the wealth of logistics related data produced on a daily basis and relate it into relevant and timely information for senior leaders and single managers who can use it to make mission critical decisions in support of *Focused Logistics*?

I.5 Investigative Questions

As mentioned in the introduction, the LTT is tasked to transform Air Force Logistics to support the Joint Chiefs of Staff vision. That task is far beyond the scope of this effort. So, working with the sponsor to limit this research effort to a suitable level has focused this project on just the Command and Control and Flexibility attributes of the Logistics

Transformation. To find a way to address this problem, this thesis effort focuses on three primary targets or focus questions.

1. What logistics information is needed by the users (senior leaders and single managers) in order to assess current capabilities in near real time, discover problem areas, and proactively address them before they become system-wide problems?
2. What potential alternatives will provide that capability?
3. How can the potential alternatives provide improved command and control as defined by the Air Force Logistics Transformation Team?

As identified in Lorraine and Michno's study, the granting of authority for the command and control of the system is a political, organizational, and doctrinal issue that may require changes that can only be recommended for Senior Air Force staff to consider.

I.6 Limitations

The Air Force Logistics Transformation is an enormous undertaking. This thesis effort looks specifically at the areas of item management and the supply chain, and focuses on how information regarding parts availability, location, movement, and repair can be used to improve logistics support to the war fighter when it is available in near real-time in one location.

This effort provides a model of the requirements for a system based on the needs and values of the decision maker and the single managers. A value-based model provides a consistent basis of comparison that can be used to show strengths and weakness in current systems and future systems.

The result of this research provides a basis for future system expansion that can incorporate all aspects of Logistics information. Information provided by this system will be able to be used for both peace and wartime environments. It does not dictate a course of action, but provides information for senior leaders and planners to make better decisions.

I.7 Scope

In order to answer the focus questions, a Value Focused Thinking (VFT) approach is used. Interviews are conducted with key senior AFMC Logistics leaders to ascertain their values regarding a Logistics information system. In addition, information systems under development around the Air Force Logistics community are reviewed to determine what is important to the supply chain managers. This review of systems is done as a proxy for interviews with the supply chain managers since their inputs are reflected by the capabilities being built into their systems. In VFT, this technique is called the Platinum Standard approach. It includes the values of the decision-maker and his organization and the values of the users or customers of the system.

The first step is to identify the basic premise behind the system to be designed and ask the interviewee what values, characteristics, and functions are important in order to reach the final goal of improving Air Force logistics support to the war fighter and how that might be measured. The outcome of the interviews is used to create a value hierarchy that is validated by the decision maker. Then additional interviews with the decision maker help create value functions for the individual measures, assign weights to these measures, and assess the risk attitude of the decision maker.

Once the requirements and measurements are determined, research will be conducted to find potential alternatives that can meet the requirements. These alternatives are then scored, and value is assessed for each alternative. Since the method for weighting the measures and scoring and valuing the alternatives is somewhat subjective, sensitivity analysis is conducted to check for changes in the recommended solution based on changes in how the analysis is conducted.

I.8 Definitions

Command and Control – "The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission." (JP 1-2, 2000: 90)

Logistics – "The science of planning and carrying out the movement and maintenance of forces. (JP 1-2, 2000: 271)

LTT Command and Control Function – "The 21st Century Aerospace Force Logistics System will become an integrated logistics network that enables asset, process and service visibility, in-process redirection, efficient use of inventory, and increased customer confidence and control." (LTT, 2000: 3)

LTT Flexibility Function - "The 21st Century Aerospace Force Logistics System will be structured for flexible and responsive support across the spectrum of operations. Emphasis will be placed on providing logisticians with the appropriate information and decision support tools required to efficiently manage variability in customer requirements and logistics system response." (LTT, 2000: 4)

I.9 Chapter Summary

This chapter describes the issue behind this research effort. The Air Force has been tasked to improve the accessibility and timeliness of Logistics information in support of Focused Logistics by the Joint Chiefs of Staff. AFMC desires to improve visibility in order to improve support to the customer. The problem and research question were presented in this chapter, along with the focus questions to help answer the research question. A value-focused approach is used to build a value based system comparison

tool. In the following chapter, a review of current literature outlines recent logistics information studies and doctrine changes.

II. LITERATURE REVIEW

II.1 Chapter Overview

As stated in Chapter 1, the mission of Logistics in the United States Air Force is changing. Through Joint Vision 2020, the Joint Chiefs of Staff have outlined a new role for the Logistics community. "The overarching focus of this vision is full spectrum dominance – achieved through the interdependent application of dominant maneuver, precision engagement, focused logistics, and full dimensional protection" (DoD JV 2020, 2000: 3). One of the interlocking aspects of full spectrum dominance is information superiority. Information superiority is defined in Joint Vision 2020 as "the capability collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same (DoD JV 2020, 2000: 8).

Obviously, logistics information is a key element in affording information superiority. So much so that it is one of the key tenets of Focused Logistics. Focused Logistics "will be made possible through a real-time, web-based information system providing total asset visibility as part of a common relevant operational picture effectively linking the operator and logistician across Services and support agencies" (DoD JV 2020, 2000: 24).

The Air Force embraced the Joint Chiefs' vision for the future and published its own Vision 2020. In this Air Force vision, the concepts of *Global Engagement: A Vision for the 21st Century Air Force* and the joint vision are reiterated and organized under the

Expeditionary Aerospace Force (EAF) concept. "EAF embodies the Air Force vision to organize, train, equip and sustain its Total Force – Active, Air National Guard and Air Force Reserve – to meet the challenges of the 21st Century" (HQ USAF/XOPE, 1999: 2). This is achieved by enhancing sustainability, readiness and responsiveness and endorsing the expeditionary way of thinking.

In order to achieve these goals, the Air Force has developed Aerospace Expeditionary Forces (AEF) defined as "a cross section of aerospace capabilities that can be tailored to meet theater CINC needs" and are considered "force management tools" (HQ USAF/XOPE, 1999: 2). They are used to organize Aerospace Expeditionary Wings (AEWs), Groups (AEGs) and Squadrons (AESs). These organizations are rapidly deployable units that can be tailored to meet any contingency need (HQ USAF/XOPE, 1999: 2-3). Since these units draw from across the Air Force Total Force, it is essential that comprehensive and timely logistics information be available to support the mission. Bases no longer deploy and support just their own. Instead, they operate as part of an integrated team, typically as part of a joint force.

This chapter starts with a brief review of applicable doctrine regarding logistics information. Following that, there is a look at the supply chain management concept and how good information flow is crucial to effective implementation. These areas set the basis for the value-focused evaluation tool created in Chapter 4. The final part of this chapter delves into command and control (C2) as it pertains to investigative question three.

II.2 Logistics Support

II.2.1 Joint Doctrine. Joint Publication 4-0, Doctrine for Logistic Support of Joint Operations states there should be "implementation of end-to-end combat support capability" (JP 4-0, 2000:I-17). This will be accomplished using "existing information technologies (IT), logistic automated information systems (AIS), and joint decision support and visualization tools" with the objective of turning JV 2020 into a reality (JP 4-0, 2000:I-17-18). The use of AIT facilitates timely and accurate data collection to be used by the AIS to create Total Asset Visibility (TAV). TAV provides a base for decision support tools that can be used to improve the support to the CINCs. JP 4-0 proceeds to dictate the utilization of current information systems, the inclusion of all logistics assets, and the ability to conduct "what-if" analysis (JP 4-0, 2000:I-17-18).

II.2.2 *Air Force Doctrine.* "Core competencies are at the heart of the Air Force's strategic perspective and thereby at the heart of the Service's contribution to our nation's total military capabilities" (AFDD 1, 1997: 27). The core competencies are Air and Space Superiority, Precision Engagement, Information Superiority, Global Attack, Rapid Global Mobility, and Agile Combat Support. All of the core competencies benefit from timely and complete information and are integrated into the application of this research endeavor.

The obvious application of improving logistics information accessibility is to Agile Combat Support. However, timely and accurate logistics information plays an important part in Information Superiority, and Rapid Global Mobility, as well (AFDD 1, 1997).

Generally looked at as an offensive tactic, information superiority also includes managing and protecting Air Force information. This is vital to the success of military operations as one of the keys to winning World War II was the demolition of the German logistics support infrastructure. It was imperative to know what was important to their operation and where it was in order to destroy it. Therefore, defending Air Force logistic information is vital.

Rapid Global Mobility requires timely movement, positioning, and sustainment of military forces (AFDD 1, 1997: 33). This strikes at the heart of logistics, but in order to be able to meet these goals timely accurate information needs to be available.

Finally, Agile Combat Support requires a seamless and responsive combat support system of systems in order to provide that support. Air Force Doctrine Document 2-4 identifies five core combat support principles: responsiveness, survivability, sustainability, time-definite resupply, and information integration (AFDD 2-4, 1999:4). The improvement of access to timely logistics information is essential to provide the flexibility necessary to support responsiveness, to fulfill the obligations of time-definite resupply of delivering, immediately resupplying, and sustaining a deployed force when and when needed, and to integrate information to improve command and control and

provide "reliable asset visibility and resource access to the war fighter" (AFDD 2-4, 1999: 6-8).

The United States' military leadership has established the preceding doctrine, and efforts have been made to implement it. This research effort supports this doctrine by establishing a tool to test the progress made to meet that intent. The next section explores how all of these aspects are part of supply chain management - an integrated process that involves the end user, and distributors, and the suppliers.

II.3 Supply Chain Management

II.3.1 More Than Just Asset Visibility.

> Supply Chain Management is a set of approaches utilized to efficiently integrate suppliers, manufactures, warehouses and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements (Simchi-Levi *et al*, 2000: 1).

This is a civilian definition, but the principles are the same as those outlined in the previous section. The Air Force is desiring to improve the logistics support to the war fighter by providing time-definite delivery and involving the war fighter in deciding how best to support the war fighter at the same time reducing the logistics footprint.

As the section title states, this is more than just asset visibility. Asset visibility is a unidirectional concept where the supplier provides information to the end user as to where items are and when they will arrive. However, it is not an interactive process

involving suppliers of raw materials and the end user in order to improve the process for everyone. Typical supply systems, including the Air Force's supply system, have stand alone goals, as do the other parties involved with logistics: transportation, maintenance, contracting and acquisition. Each party of the system desires to maximize its own effectiveness, however that is measured. The problem with this is that these performance measures may conflict to the detriment of the overall process.

Simchi-Levi *et al* (2000: 3) identify two main difficulties with supply chain integration: different facilities in the supply chain may have *different, conflicting objectives* and the *dynamic nature of the supply chain* as it evolves over time.

The Air Force also suffers from these difficulties. Each base, organization, and commander desires to look the best. A simple base example will clarify. Within each Logistics Group, each of the functions has performance measures. The Maintenance function wants to have as little weapon system down time and cost as possible associated with them. The Supply, Transportation, and possibly Contracting functions desire the same. There is an inherent conflict of interest. The only way to reduce weapon system down time and cost is through improved communication and trust that the other functions will perform as required. There are not sufficient funds in the system to stock every item in Supply, so some things must be ordered. Maintenance does not want to buy items it does not need so it waits as long as it can to order. Supply then requests faster delivery so it has less time associated with it, and Transportation pays more for shipping. In the end there are more assets in the system to meet the uncertainty created by poor

communication and information flow. This affect increases as each party tries to cover all reasonable alternatives and is often referred to as the *bullwhip effect.*

II.3.2 Importance of Information.

II.3.2.1 *Bullwhip Effect.* The bullwhip effect in the supply chain has to do with uncertainty based on the lack of free access to information by all the parties in the system. The end user might have small variability in the need for a good or service. But because the supplier sees some variability, he increases his inventory to cover the variability now creating even more variability and uncertainty for his suppliers. This continues throughout the supply chain getting more uncertain at each level. In the Air Force perspective, base supply acquires inventory based on past demand data, the depots aggregate the demand data and try to forecast based on that information. However, the acquisition personnel are trying to do their best to drive costs down, so they order in quantities to get economies of scale. The suppliers have no access to any of the Air Force demand data and thereby see only infrequent demands for large quantities when if fact the usage may be fairly level at the end user. The uncertainty of when and for how much the next order at the supplier will be drives up the cost and lead-time to the Air Force.

II.3.2.2 *Information Technology.* From the example in the previous section and the following quote, it can be easily seen that improving the communication flow and accessibility to timely logistics information should improve the overall support to the war fighter.

> Information technology is a critical enabler of effective supply chain management. Indeed, much of the current interest in supply chain management is motivated by the opportunities that appeared due to the abundance of data and the savings that can be achieved by sophisticated analysis of these data (Simchi-Levi *et al*, 2000: 11).

The Air Force policy on is centralized command and control and decentralized execution (AFDD 1, 1997: 23). In an effort to act on and improve the use of information technology improvements, units throughout AFMC have been developing their own systems. Some of the systems under development include, FIRST LOOK, TRACKER, and WSMIS-SAV. These systems mine current data systems and present information in customizable ordered reports.

For example, "TRACKER is a web-front interface into an existing AFMC database called Enhanced Transportation Automated Data System-Front End Processor (ETADS-FEP)," and provides "item managers and base level supply, transportation and maintenance users asset visibility" (Lane, 00:1). Continued improvements in TRACKER and other systems draw the Air Force closer to reaching the goals outlined in doctrine.

II.3.3 AFMC Supply Chain. In August of 2000, KPMG Consulting, LLG (KPMG) completed a GAP analysis of the AFMC supply chain that had two objectives:

- Document operational, cost and service improvement opportunities in targeted supply chain operations.
- Optimize overall supply chain support to the warfighter by identifying performance gaps and developing key recommendations for improvement.

The analysis identified five areas of assessment, strategy, infrastructure, information technology, process, and people, and a total of 16 GAPs. In general, there is a disconnect between where the Air Force has stated in its Vision it wants to go and where the rank and file populace are at. The analysis is that there need to be a culture change and a restructuring under supply chain management ideals to shape the entire supply chain into a structure that can support the Vision. KPMG also identifies information technologies as the "critical enabler" of any reengineering effort. There are too many systems, with too many conflicting languages, that do not interact well and add to confusion and the belief that much of the data in the systems are "dirty."

KPMG recommends a corporate culture change needs to be accomplished in order to change the way business is done. In addition, they also recommend that "a comprehensive SCM Decision Support System" needs to be developed. That supports the reason for this research endeavor, and the value-focused model developed later can be used to evaluate such a system.

II.3.4 *Logistics Management Decision Support System.* The Logistics Management Decision Support System (LMDSS) was created in 1991 by the Navy to

improve their visibility and accessibility to timely and accurate logistics information and analysis. Since that time, it has evolved with changes in technology to become a "Web-based, Management Information System" (Krause and Evanoff, 1999: v). During the Krause and Evanoff study, they discovered that there are key capabilities valued in the LMDSS system. These inputs were not provided to the AFMC leaders that helped create the value hierarchy in Chapter 4, but they do highly reflect the same ideas. The LMDSS list included:

- Timely, precise responses to queries independent of type of data or type/model/series
- A user friendly system that did not require extensive computer knowledge or training
- Ease of access to the system as well as maximizing the eligible number of personnel who could access the system
- Both a structured modular approach to data recovery and an ad hoc Structured Query Language (SQL) capability
- Assist tools to facilitate easy development of queries
- Graphical User Interface (GUI) capabilities designed to produce presentation quality graphics on data obtained from queries (Krause and Evanoff, 1999: 25)

Their study also attempted to determine what specific data or information requirements were desired from the system. During their survey, they received such a varied response they also found it impossible to identify every need and ended with general categories (Krause and Evanoff, 1999: 61).

II.4 Command and Control

II.4.1 Vision. At the Department of Defense level, command and control is defined as:

> the exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command

> and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission (JP1-02, 2000: 90).

When the Joint Chiefs published JV 2020, they continued explaining that it includes "planning, directing, coordinating, and controlling forces and operations, and is focused on the effective execution of the operational plan," but emphasized, "the central function is decision making" (DoD JV 2020, 2000: 31). They then stated that there are two main parts in implementing proper command and control: "command structures and processes, and the information systems and technologies that are best suited to support them" (DoD JV 2020, 2000: 32). However, the Joint Chiefs extend a note of caution regarding the involvement of senior leaders in command and control function.

> First, leaders of the joint force must analyze and understand the meaning of unit cohesion in the context of the small, widely dispersed units that are now envisioned. Second, decision makers at all levels must understand the implications of new technologies that operate continuously in all conditions when human beings are incapable of the same endurance. Third, as new information technologies, systems, and procedures make the same detailed information available at all levels of the chain of command, leaders must understand the implications for decision-making processes, the training of decision makers at all levels, and organizational patterns and procedures. The potential for overcentralization of control and the capacity for relatively junior leaders to make decisions with strategic impact are of particular importance (DoD JV 2020, 2000: 32-33).

Command and control (C2) can and will benefit from improvements in information centralization and accessibility; however, there will be a requirement for "organizational innovation and doctrinal change" (DoD JV 2020, 2000: 33).

II.4.2 Doctrine

II.4.2.1 *Joint Doctrine.* Logistics authority and control is given to the combatant command commander (CINC) in Joint Pub 4-0. "CINCs may exercise directive authority for logistics (or delegate directive authority for a common support capability)" (JP 4-0, 2000: I-6). This authority is to enable the CINC to execute approved operation plans, smooth operations, reduce risk, and eliminate duplication of effort, but does not remove Service responsibilities. CINCs are also given the authority to transfer assets between Services (JP 4-0, 2000: I-6-8).

Given the Joint vision of seamless integrated logistics between Services supporting the entire force, it is necessary for timely, accurate information to be available. Chapter 2 of JP 4-0 dictates the logistics principles and considerations that have historic significance and are to be used by CINCs in their planning and executing joint operations.

The seven principles of logistics responsiveness are simplicity, flexibility, economy, attainability, sustainability, and survivability. Responsiveness is identified as the keystone – providing the right support at the right time at the right place – without which all the others are irrelevant. Simplicity breads efficiency through standardization and reduced complexity. Flexibility is the ability to adapt and respond positively to changes in the environment or operation. In order to have flexibility, a commander must have positive command and control. Economy refers to using the least amount of resources, cost, and risk to achieve the end result. This requires balance between the three and may not allow the minimum possible in each, but requires CINC involvement. Attainability requires that it be possible to actually support any required action, and identify what can

or cannot be accomplished. Sustainability requires a long-term focus so that future operations are not negatively impacted by decisions made in the short-term. "Survivability is the capacity of the organization to prevail in the face of potential destruction" (JP 4-0, 2000: 1-3).

Fifteen logistics considerations are identified, one of which is Command and Control of Logistics. There are three key parts of command and control specified: unity of command, sound logistics planning, and logistics support systems. There must be a clear path of leadership that is provided timely and accurate information through logistics support systems in order to make plans that can react to the military's requirements (JP 4-0, 2000: II 5-6).

II.4.2.2 *Air Force Doctrine.* The Air Force has established that there will be centralized control and decentralized execution. Historically this doctrine has been executed with differing degrees of success. During the Vietnam conflict, it was more decentralized control along with the decentralized execution. This was corrected during Desert Storm as control was again more centralized, but still has room for improvement (AFDD 1, 1997: 23).

Air Force Command and Control doctrine identifies two tenets of C2. The first is unity of command. It is imperative that all parties understand the chain of command and adhere to it. Centralized control and decentralized execution reinforces this tenet. "Vertical information flow [up and down] is fundamental to centralized control" (AFDD

2-8 (DRAFT), 2001: 6). This flow of information provides commanders with the information they need to make good decisions. "Horizontal information flow is essential for common situational awareness" and enhances operator initiative and reduces uncertainty between peer levels (AFDD 2-8 (DRAFT), 2001: 6).

The second tenet is informed decision making. "Command and control should support an informed and timely decision-making process at all levels of command" (AFDD 2-8 (DRAFT), 2001: 7). Improving the timeliness and accuracy of logistics information directly supports this tenet.

This research effort incorporates these ideas into the value-based evaluation tool presented in Chapter 4. The best information is still useless unless there is the authority and ability to take action based on it.

II.5 Chapter Summary

This chapter has discussed some of the issues pertinent to evaluating the current logistics information system. In recent years, there have been changes in the way the Air Force is structured and the vision and doctrine associated with how the Air Force will conduct operations. First, this chapter review changes in vision and doctrine associated with the changing role of the Air Force and the United States. Then, there was a discussion of supply chain management and the relevant application to the Air Force supply chain in an effort to improve support to the war fighter. Finally, there was a review of command and

control doctrine. The next chapter will discuss the methodology employed in this research.

III. RESEARCH METHODOLOGY

III.1 Chapter Overview

This chapter provides an overview of Value Focused Thinking (VFT) and Decision Analysis (DA). To start, there will be a discussion on what VFT and DA are and why they are applicable to this issue. It will discuss the difference between alternative-based decisions and value-based decisions. A thorough discussion of the steps of this decision opportunity will follow. At the conclusion of the chapter there is an explanation of how the model developed for this study will be used.

III.2 Why Value Focused Thinking

III.2.1 Introduction to VFT. Value Focused Thinking is a method for evaluating situations based on what is important to the decision maker "Values are what we care about. As such, values should be the driving force for our decision making" (Keeney, 1992: 3). However, this is not the way most decisions are made. The focus is on what alternatives are available from which to choose instead of identifying what is important first, how those items relate to each other and then searching for alternatives to satisfy.

One of the first things to consider is what type of decision situation is at hand. Routine decisions or decisions that can be readily reversed at low cost do not generally justify the time required for value focused analysis. In situations where the decision cannot be reversed or the cost would be very high to do so, the effort can well pay off.

III.2.2 *Alternative Focused Thinking.* Consider a common car-buying situation. In many cases, buyers know that they want a new car, about what they are willing to spend, and maybe a few of the features or style they want. The buyer goes to a dealership, or maybe more than one, finds a few vehicles he or she likes and can afford, and picks one.

Keeney identifies five steps involved with alternative-focused decisions:

1. Recognize a decision problem
2. Identify Alternatives
3. Specify Values
4. Evaluate Alternatives
5. Select an Alternative (Keeney, 1992: 49).

By identifying alternatives first, the range of ideas for solving the problem has been restricted. In addition, the values specified in step three will be based on what is available in the already chosen alternatives. Therefore, the best decision may still be a bad decision if none of the alternatives are really satisfy the fundamental problem. Back to the car example, the salesman shows two identical cars but in different colors. While a decision can be made from the alternatives presented, the question remains regarding the choices ability to satisfy the buyers values. If the buyer chooses between two compacts, but needs the car for driving a large family around, a decision has been made. However, the decision did not satisfy the reason for purchasing a new car. For most of us, purchasing a new car is a major decision. Would it not be wiser to have some idea of what is truly important before being faced with making the decision?

III.2.3 *Value Focused Thinking.* In the previous scenario, many alternatives are available, but VFT principles have not been applied. The car buyer has a decision situation and has been presented several options from which to choose. In many cases, the decision is made based on some feeling that has no logical basis or gets lost or confused during the process. VFT provides a more logical approach. Before going to the dealership, the car buyer would sit down and evaluate what is important in a new car. What does he need to do with it? Will he be hauling large items or large numbers of people? Does he need or highly value performance? Does it have to be a certain color or have certain options? How important is fuel economy? By identifying the important elements and their relationships before being placed in the decision situation, the car buyer can evaluate each vehicle against the same measuring rod and see what comes out on top.

Furthermore, Keeney identifies various ways value focused thinking may be applied in decision situations. In fact, he separates VFT into three approaches. First there are decision problems. Here, the steps are much like those under the alternative focused method. However, steps two and three are reversed so that values are specified before the alternatives are generated. The other two approaches are considered decision opportunities and are differentiated by the timing of the establishment of the strategic objectives, either before or after the decision is made that an opportunity exists (Keeney, 1992: 50).

In this research endeavor, the strategic objectives for the decision opportunity have not been previously specified, so the next section will go in detail through the steps followed.

III.3 Decision Opportunity Steps

III.3.1 *Identification of the Decision Opportunity.* In order to identify a decision opportunity, the decision-maker must realize that an opportunity exists. Generally, this means that there has been some change in the environment that would make the decision-maker think that there may be some improvement to be found. This environmental change may be a technological advance, information that market share has decreased, or just a desire to make in improvement and the feeling that there just has to be a better way. Whatever the environmental change, the decision-maker decides that it is time to evaluate the situation based on a value structure. "The value structure encompasses the entire set of evaluation considerations, objectives, and evaluation measures for a particular decision analysis" (Kirkwood, 1997: 12).

III.3.2 *Specifying Values.* "Values provide the foundation for interest in any decision situation. Since the values that are of concern in a given decision situation are made explicit by the identification of objectives, this process is crucial" (Keeney, 1992:55). The objectives are then arranged into a value hierarchy which is a visual representation of what is most important to the decision-maker (the fundamental objective), what the key issues are that should be taken into consideration when making the decision (the evaluation considerations), and how those issues are to be measured

(evaluation measures) (Kirkwood, 1997:1-13). See Figure 1 for a graphical example of a value hierarchy.

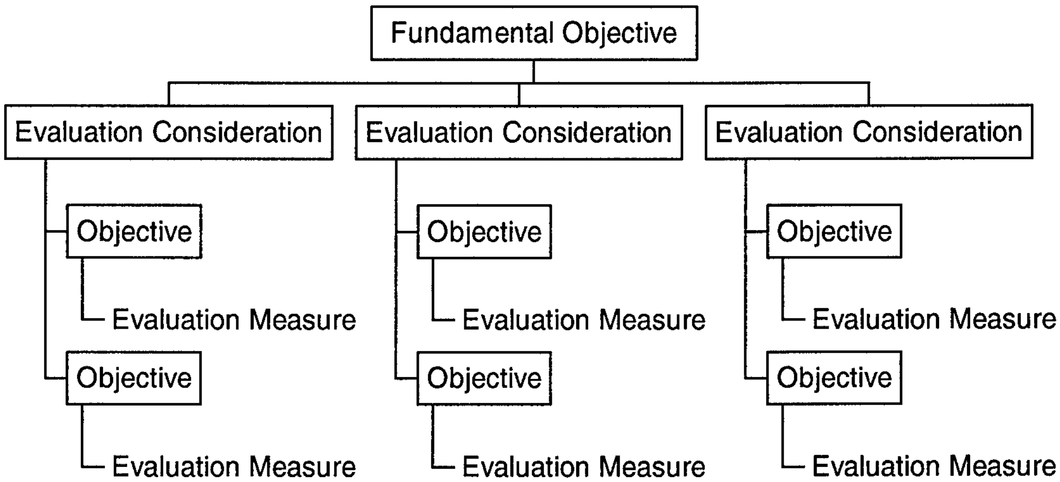


Figure 1: Generic Value Hierarchy

III.3.2.1 *Fundamental Objective.* The fundamental objective is the driving force behind the decision process and the reason for going through the effort of using the value focused approach. In determining the fundamental objective of the process, it is crucial to ask the decision-maker, "Why is that important?" Answering this question requires the decision-maker to evaluate the situation and his or her reasons for wanting to make a change. The fundamental objective is generally not an elaborate statement, but instead a concise reason for making the decision. For example, when purchasing a vehicle, the fundamental objective might be something like to purchase the best vehicle.

But what makes one vehicle better than another? The answer to this question leads to the next level of the value hierarchy.

III.3.2.2 *Evaluation Considerations.* Kirkwood defines an evaluation consideration as "any matter that is significant enough to be taken into account while evaluating alternatives" (Kirkwood, 1997:11). These may also be considered criteria or subject areas. Evaluation considerations are the broad areas on which a decision is based and often compete in the decision-maker's mind for priority, and this addressed in Section III.3.3 Weighting.

Identifying the evaluation considerations may be done through various means. Depending on the decision situation, some methods may be better than others. One method is to review relevant published materials such as strategic plans, doctrine, or vision statements, and deductively develop the value model (Kirkwood, 1997:21). This method is referred to as the Gold Standard (Parnell and Kloeber, 2000:9). Another method is to interview or host group discussions with a large number of personnel within the decision-maker's organization. The multitude of inputs are then organized using affinity groups and inductively used to develop the hierarchy. This method is called the Silver Standard (Parnell and Kloeber, 2000:9). The third method, called the Platinum Standard, relies on interviews with both the decision-maker's senior leaders and those who are impacted by the decision – the end user or customer. This interview process also utilizes affinity grouping of inputs and iterative discussion with the decision-maker to inductively create the value hierarchy (Parnell and Kloeber, 2000:9).

Using the vehicle purchase example from the previous section, an evaluation consideration might be Performance. To this point, the value hierarchy might look like Figure 2.

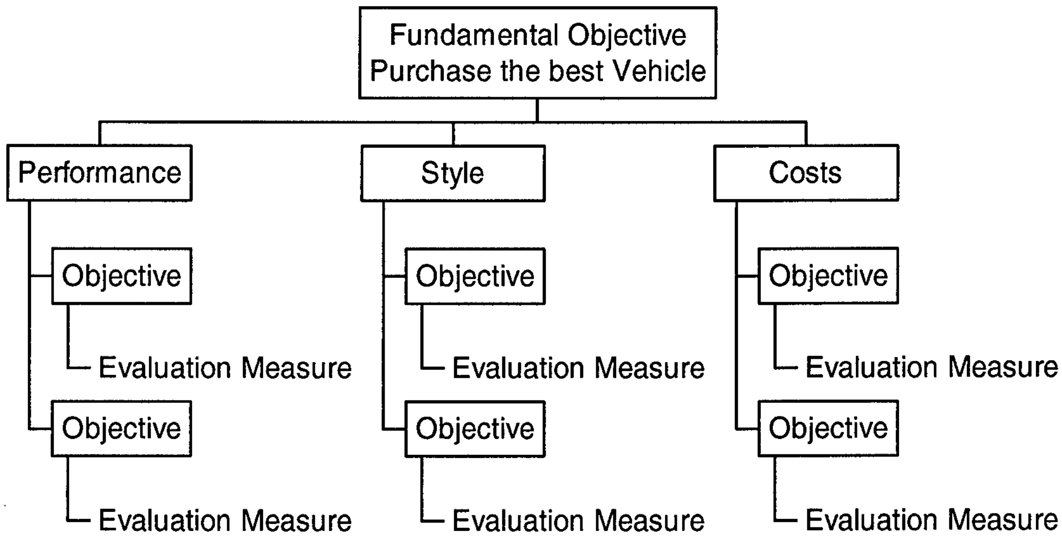


Figure 2: VFT Example Hierarchy

III.3.2.3 *Objectives.* "An objective is the preferred direction of movement with respect to an evaluation consideration." There is an assumption here that the behavior is monotonic and in any given objective more is better or less is better (Kirkwood, 1997:12). Continuing the vehicle purchasing example from before and using the Evaluation Consideration Performance, some objectives may be more horsepower, tighter cornering, and faster acceleration. Interviews with the decision-maker are used to determine which objectives are important and what direction is the desired direction.

III.3.2.4 *Evaluation Measures.* An evaluation measure is "a measuring scale for the degree of attainment of an objective" (Kirkwood, 1997:12). There are four types

of evaluation measure scales: natural, constructed, direct, and proxy. Kirkwood defines them as follows:

> Natural – in general use with a common interpretation by everyone.
> Constructed – developed for a particular decision problem to measure the degree of attainment of an objective.
> Direct – directly measures the degree of attainment of an objective.
> Proxy – reflects the degree of attainment of its associated objective, but does not directly measure this [objective].

These four types relate to each other in the matrix formation below:

Table 1: Evaluation Measures Matrix

	Natural	Constructed
Direct		
Proxy		

It is essential that the range of the evaluation measures is inclusive of all possible outcomes and, ideally, the measures pass the clairvoyance test. The clairvoyance test is simply that a clairvoyant who knows what the outcome will be can unambiguously assign a score to the outcome for each alternative (Kirkwood, 1997:28).

Maintaining the vehicle-purchasing example, the evaluation measure for the objective *More Horsepower* could be natural and direct with a range from 50 to 500 on a natural number line. However, under the Evaluation Consideration *Style*, one objective may be *Best Condition.* Obviously, there is not a natural scale for this. So how can this be measured? A constructed scale may be used with a proxy scale that would have categories like *used in poor condition*, *used in good condition*, *used in excellent condition*, and *new.*

III.3.3 *The Multiobjective Value Function.* The multiobjective value function is used when there are multiple competing goals that need to be combined to create a single value in order to evaluate multiple alternatives. The multiobjective value function is a weighted sum of individual evaluation measure functions. Therefore, this requires single dimensional value functions and weights for each evaluation measure (Kirkwood, 1997: 53). The following sections discuss the components of these items.

III.3.3.1 *Units.* The first things to consider are the units used in each of the evaluation measures. Continuing with the vehicle-purchasing example, several types of scales have already been discussed. The measurements on these scales have been both numerical and categorical. Numbers could be arbitrarily assigned to each of the categorical measures.

For instance, *new* might receive a score numerically equal to two, *used in excellent condition* would be one, *used in good condition* might be zero, and *used in poor condition* might be negative one. Now these scores could be added together with the *horsepower* score to create a single multiobjective value. However, these assignments have been arbitrarily made and are impossible to combine. If instead, the assigned scores for each category was done on a hundred scale, *new* equals 200, *used in excellent condition* equals 100, etc, then the outcome might be totally altered. To solve this problem, all of the scores can be normalized by converting each score to a proportion of its total range. When higher scores are better, the following formula can be used.

$$rating = \frac{score - lowestlevel}{highestlevel - lowestlevel}$$

When lower scores are preferred, such as with costs, the following formula can be used.

$$rating = \frac{highestlevel - score}{highestlevel - lowestlevel}$$

(Kirkwood, 1997: 57-58).

III.3.3.2 Ranges. It can be seen that the ranges are now playing an important role in the process. If the upper or lower end of the range is unobtainable, that objective is not receiving its full consideration. For example, there are no vehicles available that have 500 horsepower and the best available is 350, then the best normalized score possible is only 0.67 (350-50/500-50). Additionally, no alternative has less than 100 horsepower. Therefore changing the range from 50 to 500 to 100-350 horsepower would be appropriate.

This still leaves a problem since changing the ranges can change the outcome. In addition to that, this method also assumes that variations over each evaluation measure's range have equal importance to the decision maker (Kirkwood, 1997: 58).

III.3.3.3 *Weights.* Solving both of the problems above is easy through the use of weights. By assigning weights to each of the evaluation measures, "it is possible to account for both (1) changes in the range of variation for each evaluation measure and (2) different degrees of importance being attached to these ranges of variation." This

introduces the next issue, how to determine the weights. But before that is discussed, one last item, returns to scale, needs to be clarified (Kirkwood, 1997:59).

III.3.3.4 *Returns to Scale.* Since the whole point of this process is to capture the decision-maker's value structure, it would seem reasonable that not all movement along an evaluation measures range has the same importance to the decision-maker. Using the Objective *Best Condition* again, the range varies from negative one to two. Intuitively, there seems to be a great stigma attached to being *used in poor condition* and there is a great difference between that and *used in good condition* to the decision-maker. There may be less difference between *used in excellent condition* and *new* in the decision-maker's mind. This is called "decreasing returns to scale," and can be solved through the used of a *single dimensional value function* (Kirkwood, 1997: 60).

III.3.3.5 *Single Dimensional Value Functions.* Single dimensional value functions convert evaluation scores to values, and all values are in the range from zero to one. The process involves the decision-maker and is rather simple. Find the variation in range that has the smallest value increment (least change in importance to the decision-maker) and assign it x. Then compare the other variations in range against this.

Returning to vehicle *Condition*, let the change from *used in excellent condition* to *new* equal x. Then the change from *used in good condition* to *used in excellent condition* is determined to be the same, x, but the change from *used in poor condition* to *used in good*

condition has twice the value, $2x$. Thus $x + x + 2x = 1$, $4x = 1$, and $x = .25$, as seen in Figure 3.

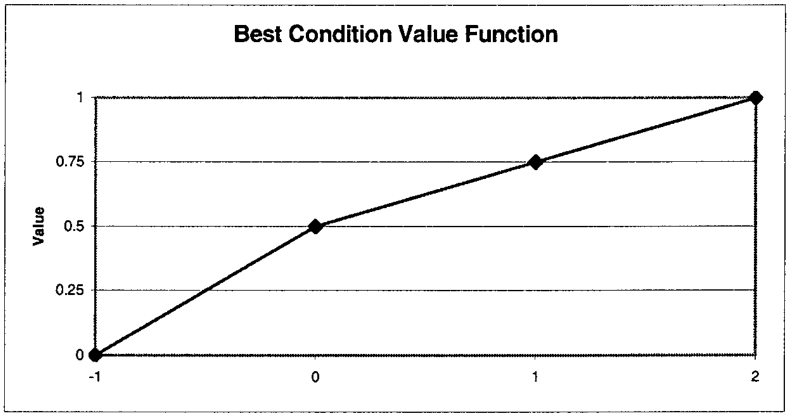


Figure 3: Best Condition Value Function

This type of value function is called a piecewise linear value function. Another frequently used type of value function is an exponential curve.

III.3.3.6 *Determining the Weights.* Weighting can be simply accomplished in much the same way as the piecewise linear value function. If all the evaluation measures are set at their lowest value and then allowed to swing, one at a time, to the highest value, the evaluation measure that creates the smallest change in overall value to the decision-maker is set at x, as before. The other changes are then determined to be some multiple of x, added together and set equal to one, and x equals the weight for the evaluation measure that creates the smallest change in overall value. The other weights are then determined from x (Kirkwood, 1997: 70).

The completed multiobjective value function now has the form:

$$v(X_a, X_b, X_c) = w_a v_a(X_a) + w_b v_b(X_b) + w_c v_c(X_c)$$

where X_x are the objectives, $v_x(X_x)$ are the single dimensional value functions, and w_x are the weights.

III.3.4 Alternatives

III.3.4.1 Generation of Alternatives. The generation of alternatives is key to making a good decision. When all the alternatives are bad, the only solution is a bad solution. It is important to not prejudice the generation of alternatives by limiting ideas or setting boundaries for the generation of ideas. Brainstorming with a panel of experts and research should yield a reasonable number of alternatives. However, as in this case, the generation of alternatives is based on the value hierarchy developed. The ideal solution will score a one. Several alternatives have been developed around AFMC and will be scored through the value hierarchy.

III.3.4.2 *Analysis of Alternatives.* Once the value hierarchy has been established and alternatives generated, the process of analyzing the alternatives is simple. Each alternative is evaluated on each evaluation measure and receives a score. The score is converted to value through the use of the single dimensional value function. Then the single dimensional values are combined through the multiobjective value function to produce a single multiobjective value for each alternative. This produces an ordinal ranking of alternatives.

III.3.5 *Sensitivity Analysis.* Since the weighting of the evaluation measures is critical to the outcome of the value function, it is imperative to check the sensitivity of the weights. This is done by varying the weight on a single evaluation measure between zero and one while maintaining the same ratio amongst the other evaluation measures. Evaluation with the decision-maker will determine what the relevant range for each evaluation measure's weight. If changes within these ranges will affect the outcome, it is important to include this information with the analysis for the decision-maker.

III.4 Application

Value Focused Thinking and Decision Analysis are normally applied in an effort to solve a difficult problem. In this instance, the procedures of Decision Analysis are used in a slightly different manner. In this study, the decision-maker may not necessarily be making a permanent decision between alternatives. This value-focused model will be used as an evaluation tool. By capturing the values of the senior leadership and single managers through the use of interviews and research, current logistics information systems will be evaluated as to how well they fill the values expressed by the decision maker. Since the current array of systems has been designed to solve functional or specific area needs, it is unlikely that any one system will do it all. Therefore, this model can be used to find the strengths and weakness of the systems, identify overlapping or lacking areas, and evaluate future proposals against a consistent set of value-based criteria.

III.5 Chapter Summary

This chapter has covered the reason for using Value Focused Thinking for this decision opportunity, and the process followed under the VFT approach. In the following chapter, the application of this methodology will be presented. There, the value hierarchy developed in conjunction with the AFMC LG/LGX is analyzed and the ideal system presented. A discussion of potential alternatives will also be presented.

IV. DATA ANALYSIS

IV.1 Chapter Overview

This chapter follows the value-focused approach outline in chapter three. The following section discusses the development of the Value Hierarchy: from initial concept through final structure. Section three explores the value functions associated with each of the evaluation measures; followed, in section four, by the enumeration of four alternatives. Weight sensitivity analysis is conducted in section five.

IV.2 Value Hierarchy

IV.2.1 *Initial Development.* Observing that the roles and requirements for Air Force logistics are changing, the Air Force Materiel Command (AFMC) Logistics Deputy Commander initiated this study. He identified a decision opportunity. It was decided to use value-focused thinking to form an evaluation tool to establish a set baseline by which to judge the systems under development to take advantage of improvements in information technology and meet the new logistics goals. Meetings with the AFMC Logistics branch chiefs and a review of system literature resulted in the initial hierarchy in Figure 4. This initial hierarchy is the result of using the Silver Standard approach mentioned in Chapter One. This first hierarchy was then reviewed by the decision-maker and some of the users of current systems. The result is the revised hierarchy seen in Figure 5. The involvement of the customers' inputs with the decision-maker's inputs makes this a Platinum Approach.

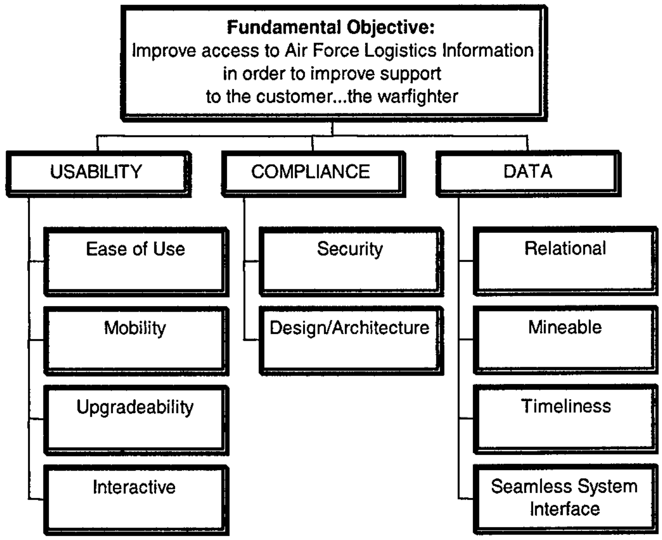


Figure 4: Initial Value Hierarchy

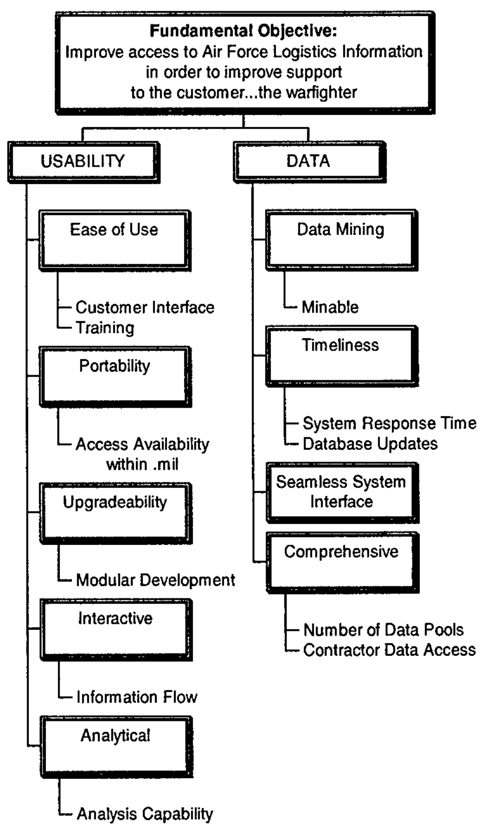


Figure 5: Revised Value Hierarchy

The fundamental objective runs parallel to the problem statement and research question put forth in Chapter One. As a review, the problem statement and research question are:

> **Problem Statement** - Current Air Force logistics information systems do not provide Air Force Material Command (AFMC) leaders and single managers a single source for real-time logistics related information that can be used to assess current capabilities and identify potential future problem items prior to the items becoming systemic problem parts.
>
> **Research Question** - How can the visibility of Air Force logistics related information be improved to near real-time in order to take advantage of the wealth of logistics related data produced on a daily basis and relate it into relevant and timely information for senior leaders and single managers who can use it to make mission critical decisions in support of *Focused Logistics*?

The level under the fundamental objective in the hierarchy structure is the evaluation considerations. They are Usability and Data. Usability deals with issues involving human user interaction with the system. Data deals with issues pertaining to system operation. These evaluation considerations were developed from affinity grouping of the inputs from the AFMC LG senior leaders and users.

On the next level of the hierarchy are the objectives. It was determined that there are nine objectives: Improved Ease of Use, Increased Portability, Enhances Upgradability, Increase Interactivity, Allows Analysis, Allows Data Mining, Improves Timeliness, Promotes Seamless System Interface, Improves Comprehensiveness. As explained in chapter three, the objectives indicate direction and use evaluation measures to determine how well alternatives meet the objectives. A description of each of the evaluation measures and the associated value functions follows in section three of this chapter.

IV.2.2 *Final Version.* Once the hierarchy was established, including the evaluation measures, it was time to add weights to the structure. Weights were established using the swing weighting techniques described in chapter three.

First local weights were established at three levels. Locals weights were determined within the two evaluation considerations and the across the two evaluation considerations. Under the Usability considerations, the base measurement was determined to be training and was set equal to x. The relationship with the other evaluation measures is shown in Table 2.

Table 2: Usability Weights

Evaluation Measure	Relationship	Weight
Customer Interface	$2x$	2/13
Training	x	1/13
Access Availability	$2x$	2/13
Modular Development	$2x$	2/13
Information Flow	$3x$	3/13
Analysis Capability	$3x$	3/13

Within the Data evaluation consideration, Seamless System Interface was set equal to x, and the relationship with the other evaluation measures is depicted in Table 3. The relationship between Usability and Data was determined to be Usability equal to two Data, weights 2/3 and 1/3 respectfully. Table 4 is a summary of all the weights rounded to two decimals.

Table 3: Data Weights

Evaluation Measure	Relationship	Weight
Mineable	$2x$	2/17
System Response Time	$2x$	2/17
Database Updates	$3x$	3/17
Seamless System Interface	x	1/17
Number of Data Pools	$5x$	5/17
Contractor Data Access	$3x$	3/17

Table 4: Summary of Weights

	Usability						Data					
	Customer Interface	Training	Access Availability within .mil	Modular Development	Information Flow	Analysis Capability	Mineable	System Response Time	Database Updates	Seamless System Interface	Number of Data Pools	Contractor Data Access
Local Weight:	0.15	0.08	0.15	0.15	0.23	0.23	0.12	0.12	0.18	0.06	0.35	0.18
Global Weight:	0.67						0.33					
Global Local Weights	0.10	0.05	0.10	0.10	0.15	0.15	0.04	0.04	0.06	0.02	0.12	0.06

The final value hierarchy used to create the evaluation tool for AFMC logistics operations includes the weights as seen in Figure 6.

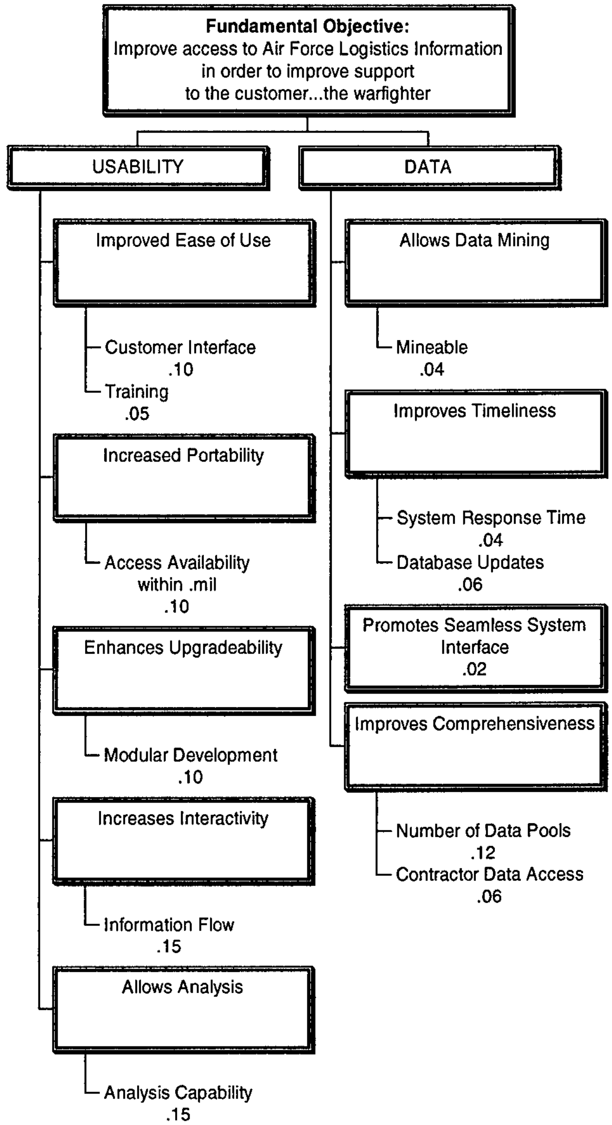


Figure 6: Final Value Hierarchy

IV.3 Evaluation Measures

Evaluation measures are used to score how well an alternative meets an objective. Table 5 is a summary of the evaluation measures.

Table 5: Evaluation Measures

Evaluation Consideration	Objective	Evaluation Measure	Type	Description
Usability	Improved Ease of Use	Customer Interface	Constructed/Proxy	Method of interaction between user and system
		Training	Constructed/Direct	Time of training required to use the system
	Increased Portability	Access Availability within .mil	Constructed/Proxy	Methods of accessing the system
	Enhances Upgradability	Modular Development	Natural/Proxy	Allows modular development or not
	Increase Interactivity	Information Flow	Constructed/Direct	Direction and level of information flow
	Allows Analysis	Analysis Capability	Constructed/Direct	Type of analysis provided
Data	Allows Data Mining	Mineable	Natural/Direct	Allows data mining or not
	Improves Timeliness	System Response Time	Constructed/Direct	Time to return requested information
		Database Updates	Constructed/Direct	Frequency of database updates
	Promotes Seamless System Interface	Seamless System Interface	Natural/Direct	Provides seamless system interface or not
	Improves Comprehensiveness	Number of Data Pools	Natural/Direct	Number of Logistics data systems accessed
		Contractor Data Access	Natural/Direct	Provides access to contractor data or not

The following sections review each evaluation measure, defining what is being measured, how it is being measured, and presenting the value function that normalizes the measure so that it can be used in a multi-objective value function to produce a single meaningful value for each alternative. The miniature hierarchy presented to the right at the beginning of each section serves as a reminder as to where each measure is within the hierarchy.

IV.3.1 *Customer Interface.* Customer interface is a measure of difficulty level for a user to negotiate the system. The scale is a constructed scale linking the type of user interface to the ease of use. The following table shows the categories constructed and the value associated with each.

Table 6: Customer Interface

Value	Category
0	*Users unable to negotiate system without technical assistance*
.1	*Users negotiate system using text or code interface*
.35	*Users negotiate system using Windows-type menu driven interface*
1	*Users negotiate using Web browser interface*

The type of customer interface is a good proxy for how easy a system is to use. If a person desiring to use a system has difficult using it because of the interface, he will not use the system to its full potential. The overall object is to improve logistics information visibility; therefore it is crucial that any system be easy to use. The categories were established with the decision-maker based on his views on what types of interfaces were easiest to use. A point to note is that a joint directive has determined that a web-based system is desired for the future logistics system.

The value function for customer interface was determined by setting the value increment of moving from *Users unable to negotiate system without technical assistance* to *Users negotiate system using text or code interface* equal to x. The value increment from *Users negotiate system using text or code interface* to *Users negotiate system using Windows-type menu driven interface* was determined to be $3.5x$, and the value increment from

Users negotiate system using Windows-type menu driven interface to *Users negotiate using Web browser interface* to be 6.5*x*. Using piecewise linear graphing results in the value function depicted in Figure 7.

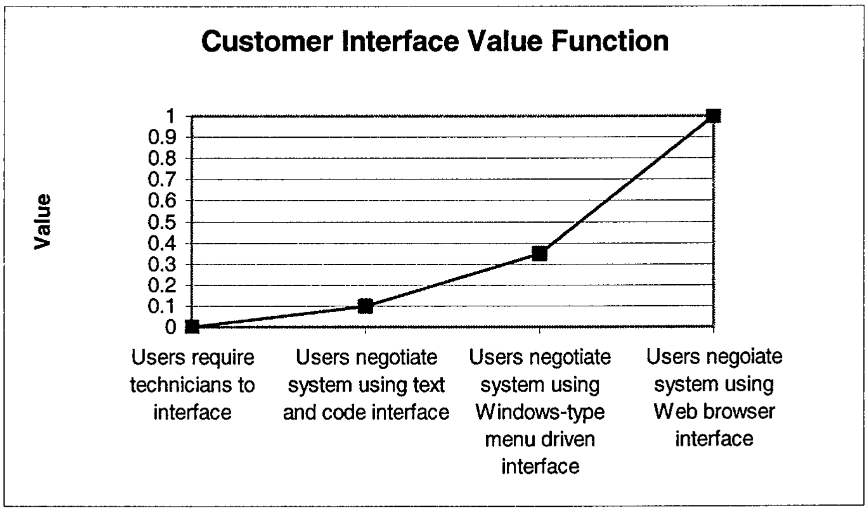


Figure 7: Customer Interface Value Function

IV.3.2 Training. Training is a measure of the amount of time a person needs to be training in order to be able to use and understand the system. It does not mean the amount of time required for a person to become an expert with the system. This is a direct constructed scale because training time is categorized into segments of one or more hours based on the decision-makers feelings regarding value from one increment to another. Table 7 shows the categories constructed and the value associated with each.

Table 7: Training

Value	Category
0	*Requires training in excess of eight hours*
.5	*Training takes more than four but less than or equal to eight hours*
.7	*Training takes more than two but less than or equal to four hours*
.9	*Training takes more than one but less than or equal to two hours*
1	*Training takes less than one hour*

Training is important because time away from the workplace is precious, especially if a TDY is required to secure the training. There is an assumption of basic functional or technical skills that would enable the user to understand what information they are looking for and what information is being requested in order to obtain the information.

The value function for training was determined by setting the value increment of moving from *Training takes less than one hour* to *Training takes more than one but less than or equal to two hours* equal to x. The value increment from *Training takes more than one but less than or equal to two hours* to *Training takes more than two but less than or equal to four hours* was determined to be $2x$, the value increment from *Training takes more than two but less than or equal to four hours* to *Training takes more than four but less than or equal to eight hours* to be $2x$, and the value increment from *Training takes more than four but less than or equal to eight hours* to *Requires training in excess of eight hours* equal to $5x$. Using piecewise linear graphing results in the value function depicted in Figure 8.

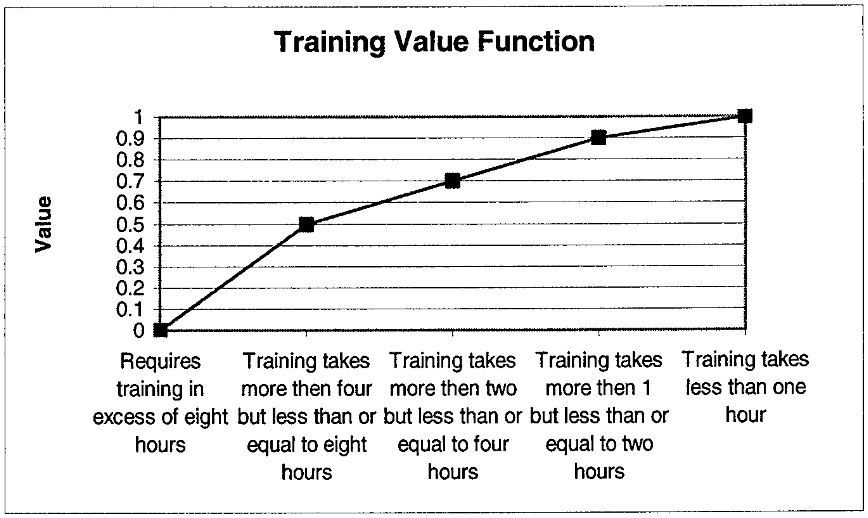


Figure 8: Training Value Function

IV.3.3 *Access Availability within .mil.* Access availability within the .mil domain is a constructed proxy measure for how portable the system is. The desire is to increase the accessibility to logistics information. However, there is a premise that there must be access to a military system in order to gain access to Air Force logistics information. This scale is based on how a user gains access to the system. The following table shows the categories constructed and the value associated with each.

Table 8: Access Availability within .mil

Value	Category
0	*No personal access*
.25	*Requires dedicated terminal*
.5	*Requires base LAN connectivity*
1	*Connect through satellite link anywhere in the world*

The move from No personal access to Requires dedicated terminal was set equal to x, and the value increment from Requires dedicated terminal to Requires base LAN connectivity was determined to be the same. Moving from *Requires base LAN connectivity* to *Connect through satellite link anywhere in the world* is equal to 2x. Solving this produces the value function in Figure 9.

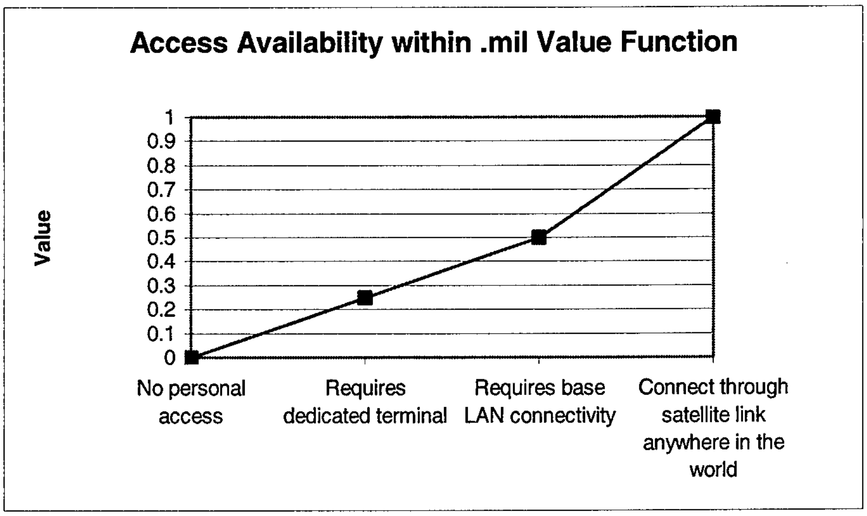


Figure 9: Access Availability Value Function

IV.3.4 *Modular Development.* Modular development is a natural but proxy measure. The measure is simply a binary decision: either yes or no. This measure is used as a proxy for upgradability. Table 9 shows the value associated to each outcome.

Table 9: Modular Development

Value	Category
0	*No*
1	*Yes*

A modularly developed system enables controlled growth and maintenance of the system. The system can be fielded as soon as core features are available, new features can be easily added, and outdated features can be easily removed to save system resources. The value function is shown in Figure 10.

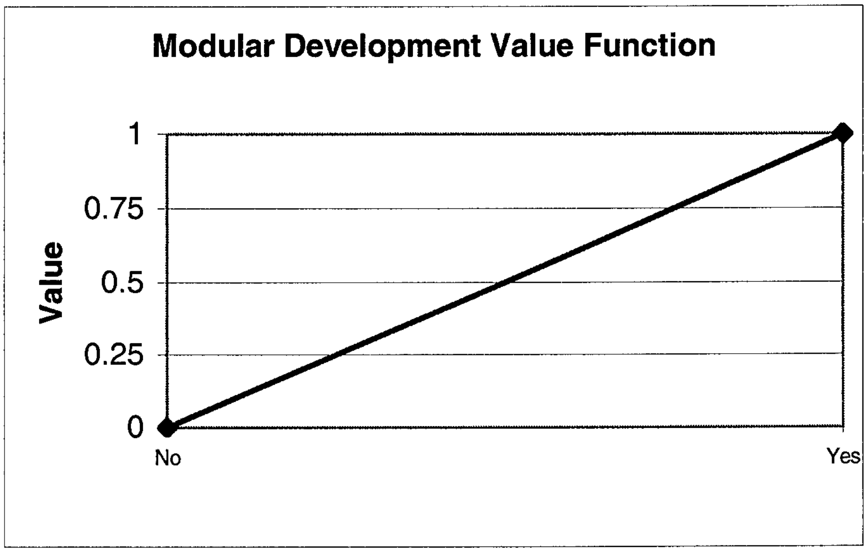


Figure 10: Modular Development Value Function

IV.3.5 *Information Flow.* Information flow is important to improving communication in the supply chain. Improved communication should lead to greater trust and better overall support. This is a direct constructed measure of the ability to have multidirectional information flow. Table 10 shows the categories and their associated values.

Table 10: Information Flow

Value	Category
0	*No data available*
.5	*Basic data presentation*
.8	*Data is presented with one-way explanations*
1	*Data is presented with two-way communication*

Another way to look at these categories might be to consider basic data presentation like a standard book: a lot of information, but no extra background. Whereas data with one-way explanations is like have the Cliff's Notes in addition to the book. Having two-way communication to like having an interactive CD-ROM that can provide additional information and can answer questions asked.

The same methodology was employed with x equal to the value increment from *Data is presented with two-way communication* to *Data is presented with one-way explanations.* Moving from *Data is presented with one-way explanations* to *Basic data presentation* is $1.5x$, and from *Basic data presentation* to *No data available* is $2.5x$, resulting in the value function shown in Figure 11.

Figure 11: Information Flow Value Function

IV.3.6 *Analysis Capability.* Analysis capability measures whether the alternative allows for data manipulation and to what degree that is available. The measure is a direct measure that has been fitted into three constructed categories as shown in the following table.

Table 11: Analysis Capability

Value	Category
0	*No data manipulation*
.5	*Generate user defined reports*
1	*Conduct "what-if" analysis*

Analysis capability is what differentiates basic data presentation from useful information exchange. Users at all levels believe it important to be able to conduct their own manipulation upon the data, whether it is a user specified report or in depth analysis of separate scenarios.

The value increments from one category to the next were determined to be equal by the decision maker, and the following value function resulted.

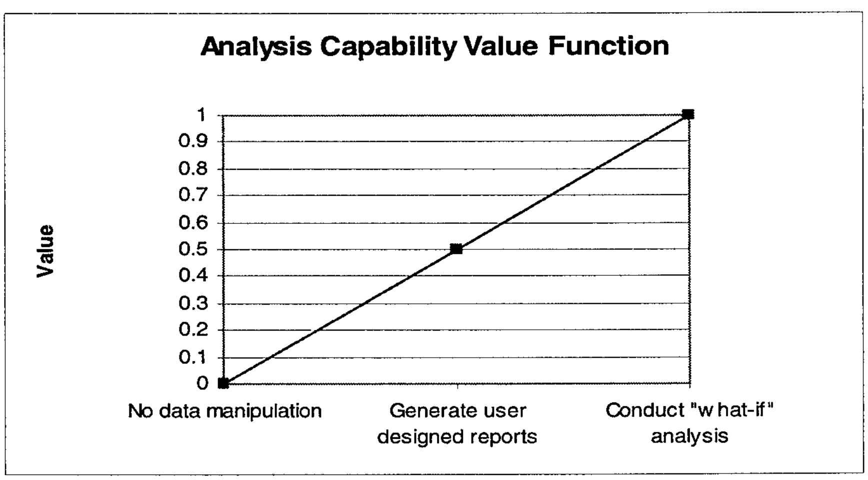


Figure 12: Analysis Capability Value Function

IV.3.7 *Mineable.* Mineable is a term created for this evaluation measure. The measure is direct natural measure that is either yes or no. The decision-maker determined the level of capability is not important since the importance of the level of capability is relevant to the situation and over-enabling the system just wastes resources. Table 12 shows the categorical values.

Table 12: Mineable

Value	Category
0	*No*
1	*Yes*

Mineable is defined by the decision-maker as the ability to see some area of interested and be able to select it and have the system retrieve even more detailed information on the subject. The decision-maker did not differentiate on whether this had to be a "point and click" operation or may require additional understanding of the system. Figure 13 is the value function.

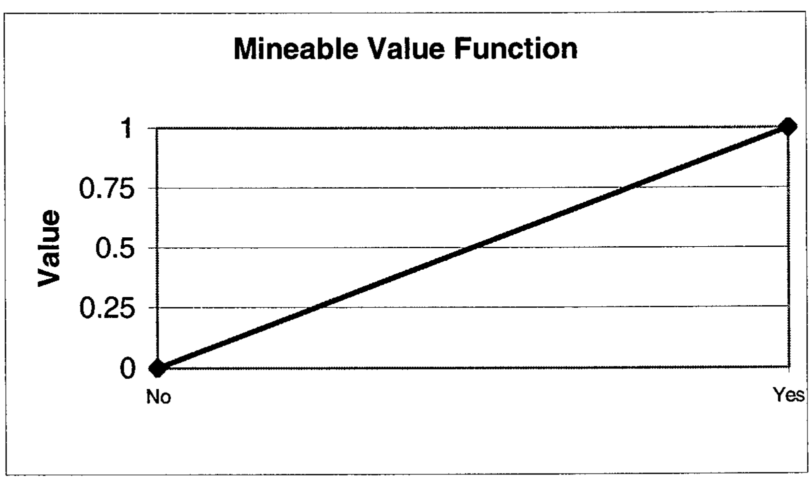


Figure 13: Mineable Value Function

IV.3.8 *System Response Time.* The time it take for the user to receive information is critical for the use of a system. The decision-maker decided on this direct constructed scale because not all time increments are valued the same. The decision-maker feels that any response that takes over 180 seconds has taken too long and rendered the system relatively useless. The following table shows the results of the value elicitation.

Table 13: System Response Time

Value	**Category**
0	*Greater than 180 seconds*
.1	*Greater than 120 but less than or equal to 180 seconds*
.2	*Greater than 60 but less than or equal to 120 seconds*
.3	*Greater than 10 but less than or equal to 60 seconds*
1	*Less than or equal to 10 seconds*

As seen in Figure 13, the value increment is the same for all category changes expect for the move from *Greater than 10 but less than or equal to 60 seconds* to *Less than or equal to 10 seconds* which is seven times as valuable as any other change. This yields the value function seen in Figure 14.

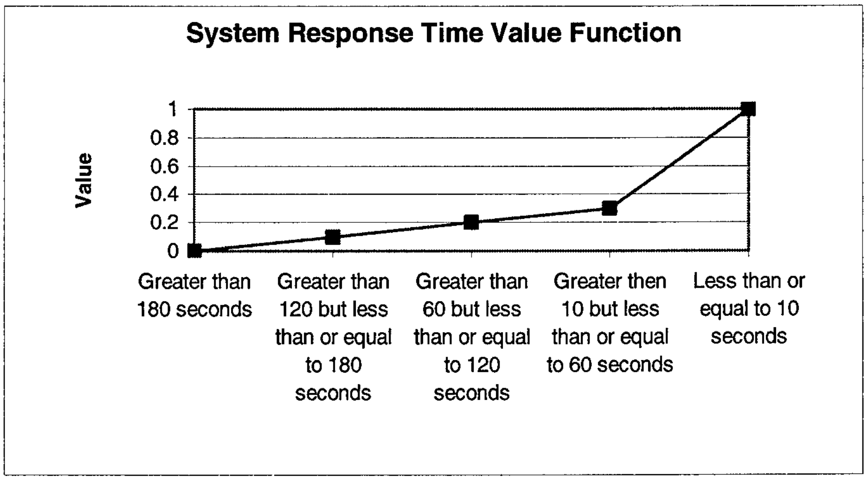


Figure 14: System Response Time Value Function

IV.3.9 *Database Updates.* Database updates is a measure of how frequently the system attempts to update data from any other systems from which it pulls data. This is a constructed scale that measures the objective directly. There are five categories to this measure as seen in Table 14.

Table 14: Database Updates

Value	**Category**
0	*Greater than monthly*
.25	*Greater than weekly but less than or equal to monthly*
.5	*Greater than daily but less than or equal to weekly*
.95	*Daily*
1	*Less than daily*

Here the base value increment is the move from Less than daily to Daily and is set to x. The move from Daily to Greater than daily but less than or equal to weekly equals 9x, from Greater than daily but less than or equal to weekly to Greater than weekly but less

than or equal to monthly equals 5x, and from Greater than weekly but less than or equal to monthly to Greater than monthly equals 5x. Transforming this into a value function yields the following figure.

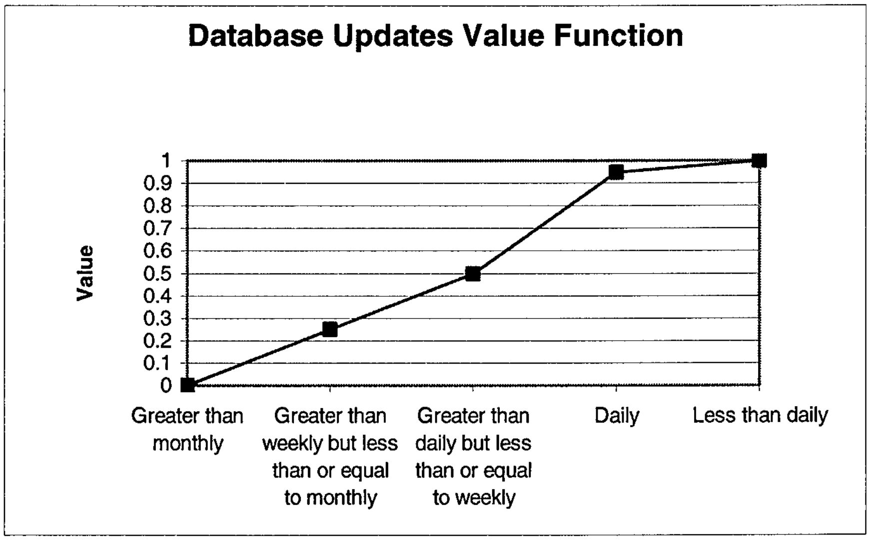


Figure 15: Database Updates Value Function

IV.3.10 *Seamless System Interface.* This measure is a natural direct measure. Either there is a seamless interface between this system and any subsystems or legacy system that it interacts with or this is not. This yields a simple allocation of value shown categorically in Table 15 and graphically in Figure 16.

Table 15: Seamless System Interface

Value	**Category**
0	*No*
1	*Yes*

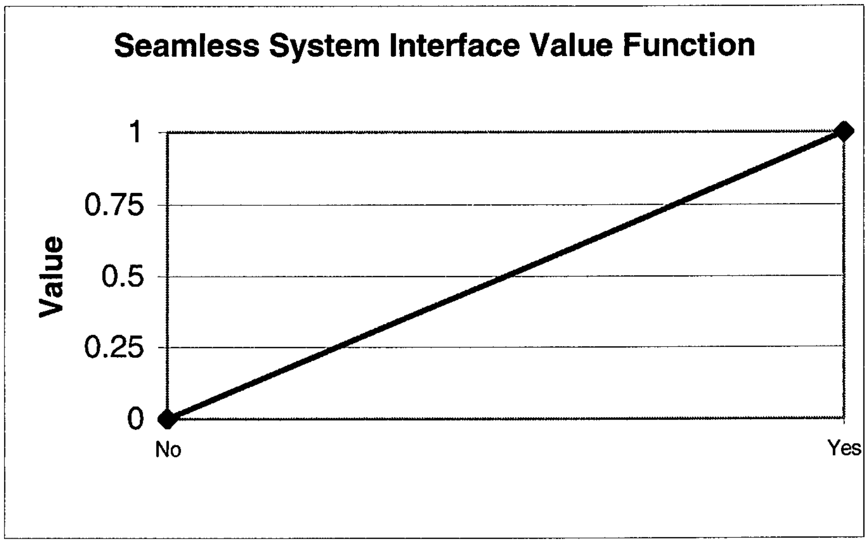


Figure 16: Seamless System Interface Value Function

IV.3.11 *Number of Data Pools.* The number of data pools accessed by any alternative is critical to determining how comprehensive the information produced will be. A natural direct scale is used for this function. It was determined that there are seven key information pools from which data could be pulled; they are Supply, Transportation, Maintenance, Acquisition, AFMC Depot functions, Defense Logistics Agency, and General Services Administration. Providing access to the widest number of sources of logistics data is critical to the long-term success of any alternative.

It was decided that the value of adding each additional data source had equal value creating a linear value function. Each value increment is one seventh as shown numerically in Table 16 and graphically in Figure 17.

Table 16: Number of Data Pools

Value	Number of Data Pools
0	*0*
.14	*1*
.28	*2*
.43	*3*
.57	*4*
.71	*5*
.86	*6*
1	*7*

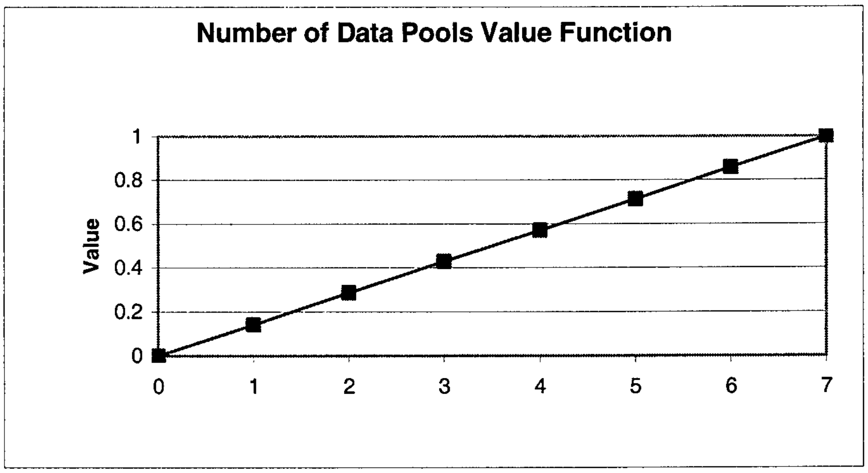


Figure 17: Number of Data Pools Value Function

IV.3.12 *Contractor Data Access.* This is a natural direct binary measure. At this point in time, the decision-maker felt it important only to differentiate between whether or not the capability exists to interact with contractor databases in order to retrieve the same type of logistics information attainable from Air Force systems. The following table and figure show the value increment and value function.

Table 17: Contractor Data Access

Value	Category
0	*No*
1	*Yes*

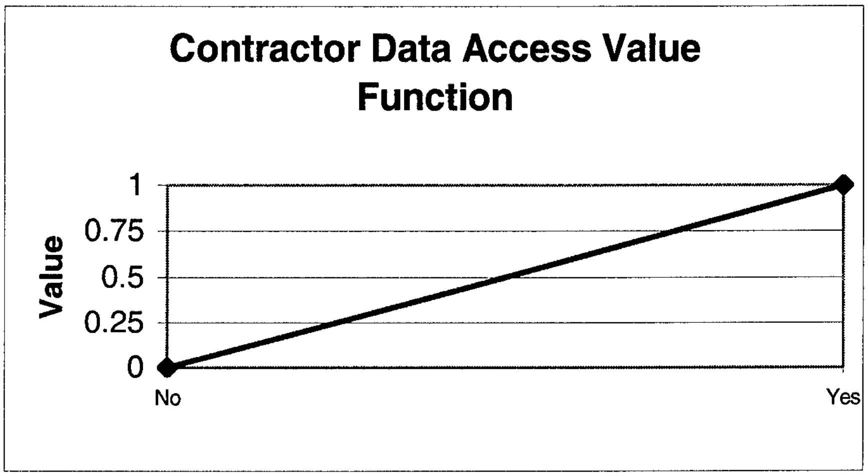


Figure 18: Contractor Data Access Value Function

IV.4 Alternatives

When determining alternatives, a couple of underlying assumptions are made. The first assumption is that any system selected by the Air Force will meet or exceed all Air Force and DoD computer security requirements, or it is not a viable alternative. There is also an assumption of data integrity. While this may or may not be true, it does not affect this model since none of the alternatives affect the initial entry of data. The only focus in this model is on the retrieval and manipulation required to organize the data.

IV.4.1 *Status Quo.* As a baseline, it is a good idea to score the current situation through the multiobjective value function. The current situation is a series of legacy

systems, which have been in existence almost the entire time the Air Force has been in existence. They are functionally and organizationally separated and have difficulty communicating. Included in these systems are the Standard Base Supply System (SBSS), CAMS and GTN. Each separate system requires special access approval and provides access through a variety of text and menu driven interfaces. Information may be retrieved by any number of standardized reports, which are generated on a set schedule and delivered to the users at some point later. Instruction on how to use current systems is part of initial technical training.

IV.4.2 TRACKER. "TRACKER is a web-front interface into an existing AFMC database called Enhanced Transportation Automate Data System-Front End Processor (ETADS-EP)" (Lane, 2000: 1). It originated several ears ago as a transportation visibility tool, but TRACKER, as a total logistics visibility tool, is an AFMC LG/LGX initiative started in 2000. The AFMC commander at that time directed an expansion to "provide item managers and base level supply, transportation, and maintenance users asset visibility as a result of the AEF Logistics IPT" (Lane, 2000: 1). TRACKER provides the capability to access information from Air Force Logistics systems as well as commercial transportation carriers, updates as frequently as every 15 minutes and data is maintained for 24 months. As long as the system is accessed from a .mil web address, it can be accessed from anywhere in the world with no additional sign-in. Once in the system, users may review standard reports or design specific inquiries (Lane, 2000).

WSMIS-SAV. The Weapon System Management Information System (WSMIS) is not a new system, but has recently been undergoing a face-lift and modernization. WSMIS is a modular system that provides mangers the following capabilities:

- Impact analysis of status on wartime capabilities
- Analysis of current mission support
- Real-time/near real-time responsiveness

Enhancement of weapon system management of spares acquisition, parts inventory, and maintenance requirements (Frabotta, 2000).

WSMIS is constructed from nine modules that provide different capabilities. The Supportability Analysis and Visibility (SAV) module is evaluated for this research since it is the first to complete the modernization process. Mr. Frabotta, the head of the WSMIS modernization team at AFMC LG/LGXX states WSMIS-SAV "provides managers a Web based capability with graphics/data to produce system logistics trends and identify problems in the Readiness Drivers Program" and "provides drill down capabilities to pin point problem" (Frabotta, 2000).

IV.4.3 *Ideal.* The Ideal alternative is a hypothetical alternative achieved by setting all of the evaluation measures at their highest scores. In short, this alternative would have the following characteristics:

- *Users negotiate using Web browser interface*
- *Training takes less than one hour*
- *Connects through satellite link anywhere in the world*
- *Has Modular Development*
- *Data is presented with two-way communication*

- *Conducts "what-if" analysis*
- *Is Mineable*
- *System responds in less than 10 seconds*
- *Database updates less than daily*
- *There is a Seamless System Interface*
- *Pulls from all Seven Data Pools*
- *Has contractor data access*

IV.4.4 Analysis of Alternatives. The existing system alternatives were scored on each of the twelve evaluation measures with the involvement of the developers of those systems. The Status Quo was scored with the assistance of the decision-maker to set a base line to measure potential alternatives against. After each of the alternatives was scored, they were processed through the multiobjective value function shown as Equation *1*.

Equation 1: Multiobjective Value Function

$$\sum \begin{matrix} w_{ci}v(ci) + w_{t}v(t) + w_{aa}v(aa) + w_{md}v(md) + w_{if}v(if) + w_{ac}v(ac) + \\ w_{m}v(m) + w_{srt}v(srt) + w_{du}v(du) + w_{ssi}v(ssi) + w_{ndp}v(vdp) + w_{cda}v(cda) \end{matrix}$$

The scores for the alternatives are shown in Table 18. The alternative score were then processed and the results of this analysis are summarized in Table 19 and graphically depicted in Figure 19. As a point of comparison, each alternative was also processed using weights for each evaluation measure equal to one twelfth. This was done to show the impact of adding weights to the model. While it did not impact the final result, it does demonstrate an impact on total value.

Table 18: Alternative Scores

	Usability						Data					
	Customer Interface	Training	Access Availability within .mil	Modular Development	Information Flow	Analysis Capability	Mineable	System Response Time	Database Updates	Seamless System Interface	Number of Data Pools	Contractor Data Access
Ideal	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	1.00	0.50	1.00	1.00	0.80	1.00	1.00	1.00	1.00	1.00	0.71	1.00
TRACKER	1.00	1.00	1.00	1.00	0.50	0.50	1.00	1.00	1.00	1.00	0.57	1.00
Status Quo	0.10	0.00	0.25	0.00	0.50	1.00	0.00	1.00	0.25	0.00	0.14	0.00

Table 19: Results of Analysis

Alternative	Total Value
Ideal - Equal Weights	**1.00**
WSMIS-SAV - Equal Weights	**0.92**
TRACKER - Equal Weights	**0.88**
Status Quo - Equal Weights	**0.27**
Ideal	**1.00**
WSMIS-SAV	**0.91**
TRACKER	**0.80**
Status Quo	**0.34**

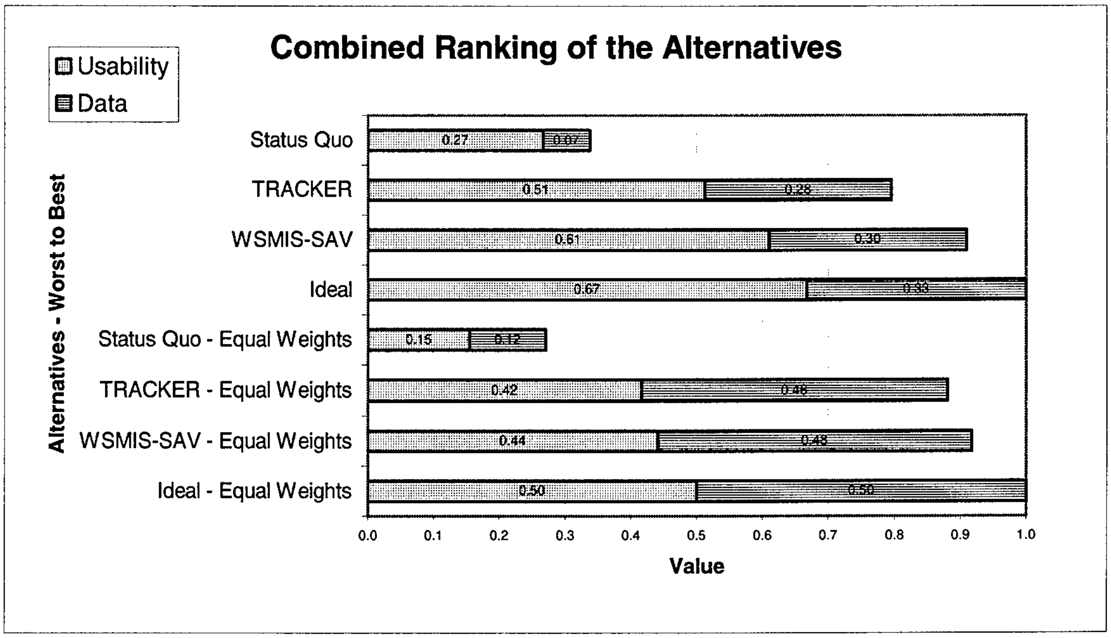


Figure 19: Graphical Representation of Alternatives Using Decision-Maker's Weights

IV.5 Sensitivity Analysis

Sensitivity analysis was conducted on the weights for each of the evaluation measures. This analysis was conducted by changing the local weights within each evaluation consideration and on the local weights of the evaluation considerations. The weights were varied from zero to one; however, this is not really realistic. Since the decision-maker has determined that each of these measures are needed, no one measure could be eliminated or eliminate all the others. A relevant range was discussed with the decision-maker and it was agreed that a range of the weight plus or minus 0.1 was a realistic relevant range. After the analysis was completed, it appears that there is no impact of changing any of the weights within their relevant ranges, but if the weights for Training or Analysis Capability are allowed to fluctuate from zero to one, there is a change in the

outcome as seen in Figure 20 and Figure 21, respectfully. The vertical lines show the location of the weights in the model: .08 for Training and .23 for Analysis Capability.

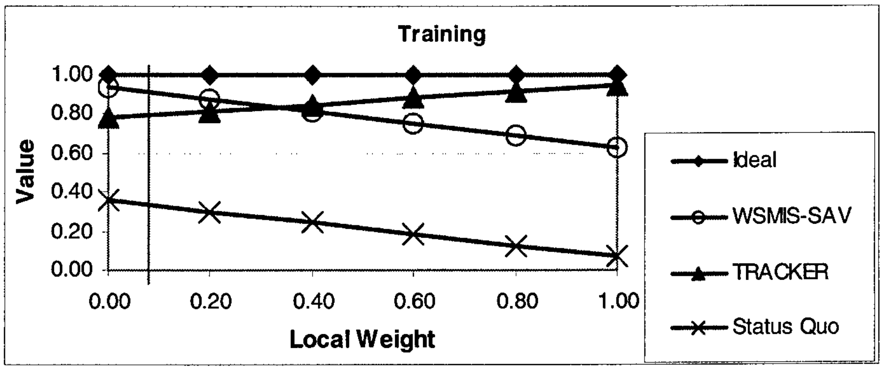


Figure 20: Training Weight Sensitivity Analysis

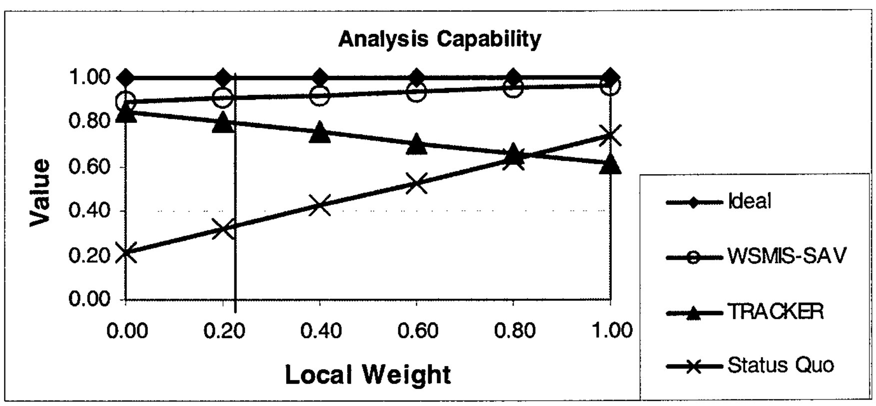


Figure 21: Analysis Capability Weight Sensitivity Analysis

Sensitivity analysis was also conducted on the weights of the two evaluation considerations, Usability and Data. Due to the fact that there are only two, it was important to test the entire range between zero and one; however, it yielded no change in the result. The complete results are in Appendix A.

IV.6 Chapter Summary

In this chapter, the value-focused evaluation tool developed for AFMC LG/LGX has been presented. An ideal Air Force Logistics information system, based on value objectives, was described, along with a description of the Status Quo, TRACKER and WSMIS-SAV. This ideal alternative is in line with the vision provided by the Joint Chiefs, and can be used as a goal and a measuring rod for current and future systems. The alternatives have been evaluated and the application of this model discussed. In the following chapter, the insight provided by the value-focused process will be used to address the research and investigative questions that are the driving force behind this research.

V. CONCLUSION

V.1 Chapter Overview

In this chapter, the investigative questions identified in Chapter 1 are answered. As a review, each question is restated, and then is answered based on the information obtained through the research and analysis conducted. The third section reviews the research question and the answers found for it. The concluding section of this chapter contains recommendations for future research.

V.2 Investigative Questions

V.2.1 Investigative Question One.

> *What logistics information is needed by the users (senior leaders and single managers) in order to assess current capabilities in near real time, discover problem areas, and proactively address them before they become system-wide problems?*

The answer to this question is, simply, it depends. During the discussions with members of the AFMC LG community to create the value hierarchy, it became apparent that the information each person required to do their job differed. It differed not only by what functional areas they were in, but by each project or question for which they were seeking answers. There did appear some common threads, however. There was an interest in combat support capability provided to the warfighter, commonly approximated by mission capable rates of the warfighter. Using this as a springboard, they then would

look for drivers behind any rates below standards. At that point, the information required differed depending on the area identified as the reason for the failure.

In order to proactively address problem parts, timely information is needed regarding increasing failure and mission capable (MICAP) rates, parts availability, repair and contract status. These are broad information areas and the specific information for each item will be different. Another aspect identified to improve mission support is improved communication flow along with the improved information flow. There needs to be timely communication between those asking questions and finding problems and those who can provide support, whether simply answers or increased functional, material, or financial support.

Since specific information requirements were elusive, the focused turned to discovering how any information that was needed could be gathered quickly, accurately and efficiently. In recent years, many organizations have started developing their own software packages to achieve the insight they desire and to support the Joint Chiefs of Staff vision expressed in JV 2020.

It was determined that a consistent value-focused tool would be helpful in judging the various systems being presented. The complete value-focused model was explained in Chapter 4. The fundamental objective for the model was determined to be *Improve Access to Air Force Logistics Information in order to improve support to the customer…the warfighter*. With that in mind, six objectives and twelve evaluation

measures were established to gauge the effectiveness of the alternatives. These Objectives include *Allows Data Mining, Improves Timeliness, Improves Comprehensiveness, Increases Interactivity, Improved Ease of Use, and Promotes Seamless System Interface.* All of these objectives are geared to providing the customer, the warfighter, a product that they can use, easily and anywhere, to find the exact information they need, when they need it. The next section looks at some of the alternatives under development to meet these goals.

V.2.2 Investigative Question Two.

What potential alternatives will provide that capability?

The explosion of information technologies and their ease of application have led to a large number of potential alternatives. However, since this study was conducted for AFMC, alternatives developed there were evaluated and the model presented to provide a tool to evaluate any other alternatives that may be presented against a consistent value-focused measure. This study evaluated four separate alternatives: Status Quo, TRACKER, WSMIS-SAV, and Ideal. The definitions for each of these alternatives are found in Chapter 4, Section 4.

Since the Ideal alternative was constructed from the top value position on each of the evaluation measures and not based on a single real alternative, it obviously performed the best with a total value equal one. WSMIS-SAV performed the next best with a total value equal 0.91, TRACKER had a total value equal 0.80, and Status Quo had a total

value equal 0.34. These value ratings provide a rank ordering of the alternatives, and a good indication of how well they relate to each other. Scoring of the alternatives can be difficult, but the creators and users of TRACKER and WSMIS-SAV participated in the scoring for their respective systems. The scores shown in Table 18 were used in the multiobjective value function to create the total value.

This model can be easily applied to any other alternatives identified in the future. And, since sensitivity analysis on the weights shows that minor fluctuations in the weights from one decision-maker to the next will have no impact on the result, this model should be useful throughout the Air Force, not just in the AFMC LG community, to evaluate logistics information systems. However, should another decision-maker decide that another Objective or Evaluation Measure needs to be included or one deleted, the value hierarchy process may be easily adapted.

V.2.3 Investigative Question Three.

How can the potential alternatives provide improved command and control as defined by the Air Force Logistics Transformation Team?

The Logistics Transformation Team (LTT) states that future logistics will provide "asset, process, and service visibility" providing "in-process redirection, efficient use of inventory, and increased customer confidence and control" (LTT, 2000:3). These concepts are incorporated into the value hierarchy, and as such receive a score and corresponding value relating to how well each alternative meets these goals. The evaluation measures are described in detail in Chapter 4, and reviewing these will show

what needs to be scored in order to make an improvement over the status quo. By providing access to data from multiple logistics functions under a drill down methodology, any customer at any level behind the .mil firewall can gain visibility of the entire process supporting his or her specific issue. If the system provides for two-way communication flow as provided for in the Ideal model, additional insight may be gained. This feature would also allow those with the authority to redirect assets in-process.

However, as Lorraine and Michno (1994) pointed out, the authority issue is the real problem behind improving command and control. Information visibility will happen as a result of improvements in technology and the application of those improvements. It has been stated in the Joint and Air Force visions and doctrine that new technologies will be incorporated, and as long as that is supported, improvements will be made. Being able to use that information effectively may require a change in organizational structure and attitude. The KPMG AFMC Supply Chain GAP Analysis identifies these issues as being key to implementing any improvements.

V.3 Summary of Findings

So, how can the Air Force improve visibility of logistics related information in order to support of *Focused Logistics*? The technology and the information exist. This research effort has established a consistent value-focused baseline usable to judge all contenders. The Air Force needs to evaluate the myriad systems under development at all levels using this evaluation tool, or another like it, in order to decide on a system or set of systems that

can be combined to provide the same capability. Joint Vision 2020 established a timeline for the capability to support *Focused Logistics* to exist, and time is rapidly passing.

There needs to be a decision made to proceed with a single Air Force level system in order to conserve precious Air Force resources of time and money. Using a consistent value-based tool, such as the one developed here, will provide a non-political method to make that decision. This method removes barriers of eliminating some programs instead of others because the decision is made on a consistent basis and purposefully does not include the cost of the system. Once alternatives are evaluated based on value, then alternatives that rank at the top can be scrutinized based on cost. The ranking produced by this method is on an integral scale, meaning that there is something to the order and the differences between them. Since the establishment of the value hierarchy is subjective to the decision-maker, the difference between two scores with the same first significant digit may not be that great. As the differences get larger there is a clear indication of a significant difference in value.

V.4 Recommendations for Further Research

This research established the basic value hierarchy for this process. In order to ensure the widespread application and acceptance of this model, additional research may be considered.

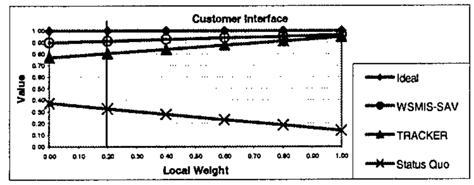
First, a wide spread search for additional alternatives may yield interesting new results. While the decision-maker is satisfied with the current evaluation, the introduction of additional alternatives may find a better solution.

Second, uncertainty and probability could be introduced into the model. Several of the Evaluation Measures were established as binary, yes or no, answers because that was the level of concern at this time. Expanding the scales on these measures may provide additional differentiation between alternatives. In addition, some of the measures have scales that have been artificially constructed into bins. This was done because the decision-maker felt most comfortable looking at it in this manner, and it was determined that scoring on a more defined scale might be impossible due to data collection. In this respect, probability distributions might be applied if there was some basis on which to establish them.

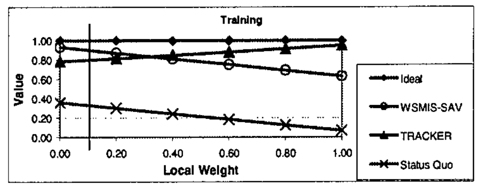
Finally, in order to improve the widespread acceptance of this model as an evaluation tool, additional surveys could be conducted to include other major commands or different levels of users to get their value inputs. Grouping these inputs through the use of infinity diagrams, as done in this study, may or may not reveal additional Evaluation Considerations, Objectives, or Evaluation Measures. If this is happens, further efforts with the decision-maker would need to be accomplished to incorporate this new input.

APPENDIX A. SENSITIVITY ANALYSIS

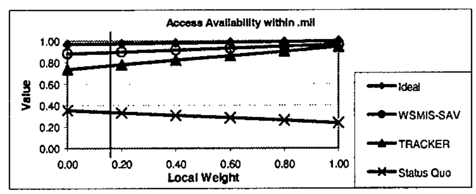
Customer Interface	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.90	0.91	0.93	0.94	0.95	0.97
TRACKER	0.77	0.80	0.84	0.88	0.91	0.95
Status Quo	0.37	0.33	0.28	0.23	0.18	0.14



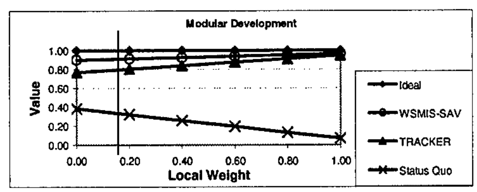
Training	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.93	0.87	0.81	0.75	0.69	0.63
TRACKER	0.78	0.82	0.85	0.88	0.92	0.95
Status Quo	0.36	0.30	0.24	0.19	0.13	0.07



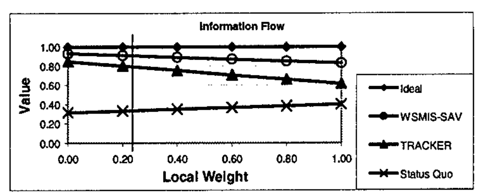
Access Avliability within .mil	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	0.97	0.98	0.98	0.99	0.99	1.00
WSMIS-SAV	0.88	0.90	0.92	0.93	0.95	0.97
TRACKER	0.74	0.78	0.82	0.86	0.91	0.95
Status Quo	0.36	0.33	0.31	0.28	0.26	0.24



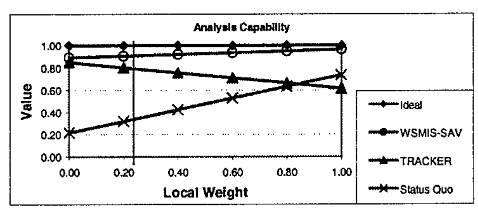
Modular Development	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.90	0.91	0.93	0.94	0.95	0.97
TRACKER	0.77	0.80	0.84	0.88	0.91	0.95
Status Quo	0.39	0.32	0.26	0.20	0.13	0.07



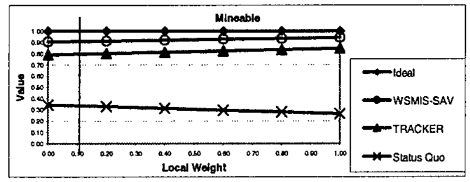
Information Flow	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.93	0.91	0.89	0.87	0.85	0.83
TRACKER	0.85	0.80	0.76	0.71	0.66	0.62
Status Quo	0.32	0.33	0.35	0.37	0.39	0.40



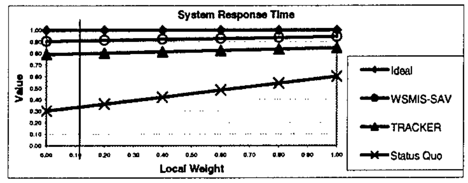
Analysis Capability	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.89	0.91	0.92	0.94	0.95	0.97
TRACKER	0.85	0.80	0.76	0.71	0.66	0.62
Status Quo	0.22	0.32	0.43	0.53	0.63	0.74



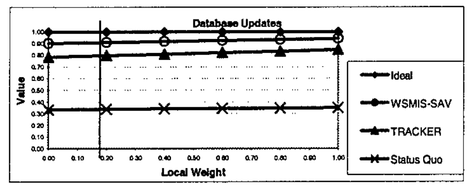
Mineable	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.91	0.91	0.92	0.93	0.94	0.94
TRACKER	0.79	0.80	0.81	0.82	0.83	0.85
Status Quo	0.35	0.33	0.31	0.30	0.28	0.27



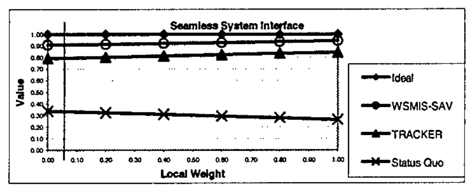
System Response Time	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.91	0.91	0.92	0.93	0.94	0.94
TRACKER	0.79	0.80	0.81	0.82	0.83	0.85
Status Quo	0.30	0.36	0.42	0.48	0.54	0.60



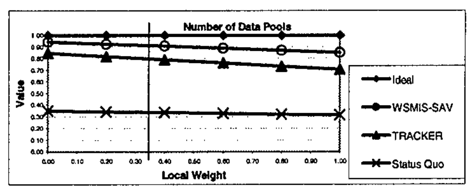
Database Updates	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.90	0.91	0.92	0.93	0.94	0.94
TRACKER	0.78	0.80	0.81	0.82	0.83	0.85
Status Quo	0.33	0.34	0.34	0.34	0.35	0.35



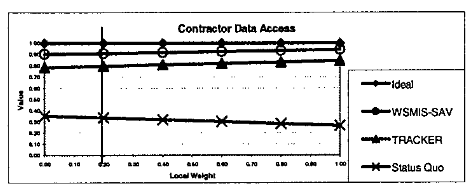
Seamless System Interface	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.91	0.92	0.92	0.93	0.94	0.94
TRACKER	0.79	0.80	0.81	0.82	0.84	0.85
Status Quo	0.34	0.33	0.31	0.30	0.28	0.27



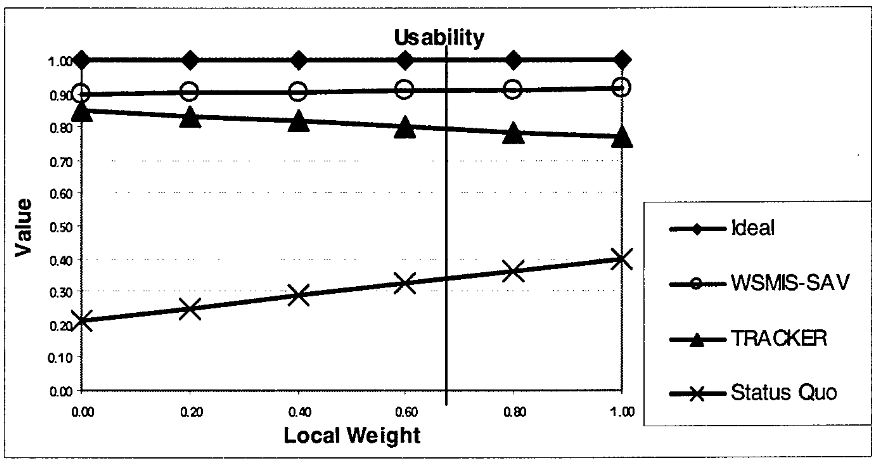
Number of Data Pools	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.94	0.92	0.91	0.89	0.87	0.85
TRACKER	0.85	0.82	0.79	0.76	0.73	0.70
Status Quo	0.35	0.34	0.34	0.33	0.32	0.31



Contractor Data Access	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.90	0.91	0.92	0.93	0.94	0.94
TRACKER	0.78	0.80	0.81	0.82	0.83	0.85
Status Quo	0.35	0.34	0.32	0.30	0.28	0.27



Usability	0.00	0.20	0.40	0.60	0.80	1.00
Ideal	1.00	1.00	1.00	1.00	1.00	1.00
WSMIS-SAV	0.90	0.90	0.91	0.91	0.91	0.92
TRACKER	0.85	0.83	0.82	0.80	0.79	0.77
Status Quo	0.21	0.25	0.29	0.32	0.36	0.40



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VITA

Capt Darrell O. Burghard was born in Chicago Heights, Illinois. He grew up in San Antonio, Texas, and graduated from MacArthur High School in 1987. Capt Burghard received his Bachelor of Business Administration (BBA) from Baylor University in May 1991. After spending four years working in the private sector, he attended Officer Training School (OTS), Maxwell AFB, Alabama, and received his commission as a Second Lieutenant August 11, 1995. His first assignment was to Fairchild AFB, WA, where he served as the Combat Operations Support Flight Commander and the Officer in Charge of the HAZMAT Pharmacy. In August 1997, he moved to Sheppard AFB, TX where he served as the Supply Flight Commander. There, he led his flight to an Outstanding Inspector General rating. In August 1999, Capt Burghard moved his family to Wright-Patterson Air Force Base to attend courses at the Air Force Institute of Technology (AFIT) for a Master of Science in Logistics Management. He successfully completed the courses and graduated in March 2001. Capt Burghard has a follow-on assignment at Headquarters Air Force Materiel Command, Wright-Patterson AFB, Ohio.

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 074-0188*

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – To)*
20-03-2001	**Master's Thesis**	Apr 2000 – Mar 2001

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
LOGISTICS TRANSFORMATION: CENTRALIZING AIR FORCE LOGISITCS INFORMATION COMMAND AND CONTROL	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
Burghard, Darrell O, Capt, USAF	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)	8. PERFORMING ORGANIZATION REPORT NUMBER
Air Force Institute of Technology Graduate School of Engineering and Management (AFIT/EN) 2950 P Street, Building 640 WPAFB OH 45433-7765	AFIT/GIM/ENS/01M-04

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
HQ AFMC/LGX, Col Gary R Ryden, Chief Logistics Plans, Programs, and Integration Division. 4375 Chidlaw Rd, Wright-Patterson AFB, OH 45433, DSN 674-1242, gary.ryden@wpafb.af.mil	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Current Air Force logistics information systems do not provide Air Force leaders and single managers a real-time sole-source logistics information system able to assess current capabilities and identify potential future problem items prior to becoming systemic problem parts. Centralizing information may provide improved command and control and support of the warfighter by reducing the time it takes to track down and identify information. Using a Value Focused Thinking approach, this thesis explored how the Air Force can improve the accessibility of Air Force logistics information. This study began at the behest of the AFMC LG/CD in an effort to determine what logistics information is important and how it might be centrally managed. Working with AFMC Logistics Group personnel, a value-based evaluation tool was developed to establish core requirements for an ideal centralized logistics information system. The value model was used to evaluate the status quo and two AFMC systems, WSMIS-SAV and TRACKER. This provides a base-line value of the current system and demonstrates how the model can be applied to evaluate other alternatives. The results show the status quo was the lowest ranking alternative.

15. SUBJECT TERMS

Logistics management, Logistics planning, Information systems, Command and control systems, Value focused thinking, Decision analysis

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
					Maj Marvin A Arostegui AFIT/ENS
a. REPORT	b. ABSTRACT	c. THIS PAGE	UU	94	19b. TELEPHONE NUMBER *(Include area code)*
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